UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

February 11, 2016

PC Code: 129121
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MEMORANDUM

SUBJECT: **Fipronil:** Ecological Risk Assessment for FIFRA Section 18 Emergency Exemption Requests for Use on Tawny Crazy Ant in Louisiana and Texas

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TO: Andrea Conrath, Risk Manager Reviewer
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Registration Division (7505P)

The Environmental Fate and Effects Division (EFED) has reviewed FIFRA Section 18 emergency exemption requests submitted by Louisiana and Texas for use of fipronil to control tawny crazy ant. These requests are for use of Termidor® SC as a structural perimeter treatment with a maximum single application rate of 0.0075 lb ai/1000 ft^2 (0.327 lb ai/A) with the number of applications limited to 2 per year (minimum reapplication interval of 60 days). The perimeter treatment is limited to 3 ft up the side of the structure and 10 ft out from the perimeter of the structure.

A previous EFED ecological risk assessment for a FIFRA Section 18 request for use of fipronil to control tawny crazy ant in Louisiana (DP 416110) assessed this same use at this same maximum application rate, maximum number of applications, and minimum reapplication interval. The risks associated with these new exemption requests would be expected to be the same as those identified in DP 416110 (direct risks to all taxa except freshwater fish and aquatic plants and indirect risks to all taxa). Therefore, as long as the similar exemption requests conform to this application rate, number of applications, and reapplication interval, EFED

believes DP 416110 (Attachment 1) provides an accurate reflection of the risks posed by the recently received and future exemption requests, and no further assessment is needed.

Attachment 1. FIFRA Section 18 Quarantine Exemption for the Use of Fipronil to Control the Tawny Crazy Ant in Louisiana (DP 416110)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C., 20460

OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION

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January 31, 2014

MEMORANDUM

SUBJECT: FIFRA Section 18 Quarantine Exemption for the Use of Fipronil to Control the Tawny Crazy Ant in Louisiana

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The Louisiana Department of Agriculture and Forestry is requesting a quarantine exemption under Section 18 for the expansion of the use of a soluble concentrate formulation of fipronil (Termidor® SC, EPA Reg. # 7969-210), a phenylpyrazole, to control the tawny crazy ant (*Nylanderia fulva*) around man-made structures (including buildings). Termidor® SC is currently registered for use as a perimeter treatment with applications of 1 ft up the side of the structure and 1 ft out from the perimeter of the structure. The quarantine exemption application requests that the use be expanded to 3 ft up the side of the structure and 10 ft out from the perimeter of the structure. If granted as proposed, the quarantine exemption would be in effect for three years after its approval date. The exemption is being sought for those Louisiana parishes (12) in which the presence of the tawny crazy ant has been verified: Ascension, Calcasieu, East Baton Rouge, Iberville, Lafayette, Lafourche, Morehouse, Orleans, St. Bernard, St. Tammany, Terrebonne, and West Baton Rouge. The proposed maximum single application rate is 0.0075 lb ai/1000 ft^2

(0.327 lb ai/a) with the number of applications not to exceed 2 per year (minimum reapplication interval of 60 days).

This ecological risk assessment concludes that the expanded application of fipronil around the perimeter of man-made structures in Louisiana may present direct risks to all taxa except freshwater fish and aquatic plants. Indirect risks are possible for any species that relies on an affected species for survival and/or reproduction (Table 1).

Table 1. Summary of Levels of Concern (LOCs) Exceeded for the Proposed Section 18 for Expanded Fipronil Perimeter Use on Man-Made Structures

	Taxonomic Group							
	Birds	**Mammals**	**Terr. Plants**	**FW Fish**	**E/M Fish**	**Aquatic Invert.**	**Aquatic Plants**	**Terr. Inverts.**
Direct Effect	✓	✓	✓	--	✓	✓	--	✓
Indirect Effect	✓	✓	✓	✓	✓	✓	✓	✓

Concentrations of fipronil and its toxicologically-important degradates tend to persist in the environment and increase over time with each additional fipronil application. The aquatic exposure values used in this assessment were based on the maximum modeled value obtained over the first three years of application to match the three year duration of the proposed quarantine exemption. If the exemption is extended beyond this period, or a new use is requested in the future that converts the quarantine exemption application rates into a permanent use, the aquatic exposure would likely be higher and the aquatic exposure estimates may need to be revised.

I. Background

The Louisiana Department of Agriculture and Forestry is applying for a Section 18 Quarantine Exemption for the expansion of the perimeter use of fipronil, formulated as Termidor® SC (EPA Reg. # 7969-210), to control the invasive species tawny crazy ant (*Nylanderia fulva*) around man-made structures. This is the first time that Louisiana has made this request; a similar quarantine exemption request was made by Texas and granted in 2009. The total area treated will depend on the number of affected structures within the 12 Louisiana parishes that have been confirmed to contain tawny crazy ants. These parishes include: Ascension, Calcasieu, East Baton Rouge, Iberville, Lafayette, Lafourche, Morehouse, Orleans, St. Bernard, St. Tammany, Terrebonne, and West Baton Rouge. The proposed maximum single application is 0.0075 lb ai/1000 ft^2 (0.327 lb ai/A) with the number of applications not to exceed 2 per year (minimum reapplication interval of 60 days). The formulation is applied as a low pressure coarse spray. The proposed period of the quarantine exemption is three years from the date of its approval.

II. Previous Actions on Fipronil

The most recent comprehensive EPA review of fipronil was issued in May 2011, with the development of the Problem Formulation Scoping Document (USEPA, 2011a, D387319) in support of Registration Review for fipronil. In general, risk assessments from 1996 through 2007 identified the following risks to non-target taxa: estuarine/marine and freshwater invertebrates,

freshwater and estuarine/marine fish, birds, and mammals. In particular, the risk assessment conducted in support of the Reregistration Eligibility Decision (RED) (USEPA, 2007, D331595+) identified risk concerns for: terrestrial invertebrates, birds and mammals (acute and chronic), freshwater and estuarine/marine invertebrates (acute and chronic), freshwater benthic organisms (acute), and estuarine/marine fish (chronic).

III. Fate Profile for Fipronil

Fipronil dissipation appears to be dependent on photodegradation in water, microbially-mediated degradation, and soil binding. Data indicate that fipronil is relatively persistent and immobile in terrestrial environments. In aquatic environments, a determination of the environmental behavior of fipronil is more tentative because soil and aquatic metabolism studies provide contradictory data on fipronil's persistence to microbially-mediated degradation processes. Photolysis is expected to be a major factor in controlling fipronil dissipation in aquatic environments. Fipronil is highly bioaccumulative in fish (380x in the whole body); however, 99% of these residues were lost from the fish during the 14-day depuration period.

Fipronil degrades to form persistent and immobile degradates [fipronil sulfide (MB 45950), fipronil sulfone (MB 46136), and MB 46513]; these degradates are considered in the HED dietary tolerance expression for fipronil. Given that fipronil and its degradates have a moderate to high sorption affinity to organic carbon, it is likely that sorption to soil organic matter will limit fipronil residue movement into ground and surface waters. However, fipronil and degradate residues may have the potential to move to groundwater in very vulnerable soils (*e.g.*, coarse-textured soils with low organic matter content) and to surface water when bound to particles entrained in runoff from erodible soils.

IV. Exposure Estimation

Aquatic Exposure

The PRZM/EXAMS model was used to provide estimated environmental concentrations (EECs) of fipronil and its degradates from use around the perimeters of man-made structures in Louisiana (Tables 2 and 3). The inputs and general modeling methods used to calculate EECs followed those in the RED risk assessment (USEPA (2007) with the following modifications: the proposed application rate (0.327 lb ai/A) and interval (60 days) was modeled, updated fate data were incorporated (Table 2), Louisiana meteorological data was used, and a toxic equivalents (TEQ) approach was employed. The TEQ approach was considered the most appropriate approach because some of fipronil's degradates are more toxic to non-target organisms than the parent fipronil. The TEQ approach allows exposure to the combination of parent and degradates to be expressed in terms of the parent alone by summing the EECs after correcting for each degradate's toxicity relative to the parent's toxicity.

Table 2. PRZM/EXAMS Input Parameters for Fipronil and Degradates.

Parameter	Fipronil	Fipronil Sulfide	Fipronil Sulfone	MB46513
Soil K_{OC} (g/mL)	727[1] (MRID 44039003)	3911[1] (MRID 44537902)	4208[1] (MRID 44537901)	1290[1] (MRID 44262831)
Aerobic Soil Metabolism $t_{½}$ (days)	218 (MRID 42918663)	700 (Assumed)	700 (Assumed)	660 (MRID 44262830)
Aqueous Photolysis $t_{½}$ (days)	0.33 (MRID 42918661)	Stable (No data)	Stable (No data)	7 (MRID 42918661)
Hydrolysis $t_{½}$ at pH 7	Stable (MRID 42194701)	Stable (No data)	Stable (No data)	Stable (No data)
Aerobic Aquatic Metabolism $t_{½}$ (days)	33.7[2] (MRID 44661301, 44261909)	1400 (2 × ASM $t_{½}$)	1400 (2 × ASM $t_{½}$)	1400 (2 × ASM $t_{½}$)
Anaerobic Aquatic Metabolism $t_{½}$ (days)	160 (MRID 44661301, 44261909)	Stable (MRID 49151519)	Stable (MRID 49151519)	Stable (MRID 49151519)
Water Solubility (mg/L)	2.3 (MRID 47723915)	0.04 (USEPA 2007)	0.16 (MRID 44350001)	0.95 (MRID 44350002)

[1]Mean KOC value.
[2]90th percentile of the observed half-lives.
ASM = Aerobic soil metabolism.

Since the 2007 assessment, USEPA has developed a standard residential exposure scenario using a quarter acre lot and houses with a 1000 ft^2 footprints. Houses are assumed to be square with sides of 31.6 ft and a 15 ft. wide driveway to the house. Therefore, the perimeter of the house that is treated on sod or lawn (pervious surfaces) within 10 feet of the house foundation is:

$$(31.6\text{ft} \times 2\text{sides} + 51.6\text{ft} + 36.6\text{ft}) \times 10\text{ft} = 1514\text{ft}^2$$

Where: 31.6 ft is the length of the 2 sides of the house; 51.6 ft is 31.6 ft along the back of the house plus two 10 ft perimeter widths (to account for the corner areas of the perimeter); and 36.6 ft is 51.6 ft treated on the front of the house minus the 15 ft driveway width.

Potentially, there is an additional 3 ft of the walls of the house that is treated which has the potential to wash-off to this same area of pervious surface:

$$(31.6\text{ft} \times 4\text{sides} - 15\text{ft driveway}) \times 3\text{ft} = 334.2\text{ft}^2$$

Therefore the total area of treatment that may drain through pervious area is 1839.2 ft^2 (1514 ft^2 + 379.2 ft^2).

Given the wash-off uncertainty from the walls of the treated structure, low and high exposure scenarios were created to bracket the actual exposure. Under the low exposure scenario, it is assumed that treatment to horizontal surfaces (lawn and sod) run off the treated area. Under the high exposure scenario, it is assumed that treatment to both horizontal and vertical surfaces (lawn, sod, and walls) run off the treated area. In the low exposure scenario, the fraction of the watershed that is treated and expected to drain through pervious surfaces is:

$$1514\text{ft}^2/\text{house} \times 58\text{houses/watershed} \div 1076391\text{ft}^2/\text{watershed} = 8.158\%$$

(low exposure scenario from pervious surfaces)

In the high exposure scenario, the fraction of the watershed that is treated and expected to drain through pervious surfaces is:

$$1848.2\text{ft}^2/\text{house} \times 58\text{houses/watershed} \div 1076391\text{ft}^2/\text{watershed} \times 100 = 9.96\%$$

(high exposure scenario from pervious surfaces)

Additionally under the high exposure scenario, the area of the side of the house that is treated (up to 3 ft) and assumed to wash-off to a 15 ft wide driveway (impervious surface) is:

$$3\text{ft} \times 15\text{ft} = 45\text{ft}^2$$

Therefore:

$$45\text{ft}^2/\text{house} \times 58\text{houses/watershed} \div 1076391\text{ft}^2/\text{watershed} \times 100 = 0.2425\%$$

(high exposure scenario from impervious surfaces)

Note that neither the low nor the high exposure scenario assumes that the driveway is treated with fipronil.

The aquatic exposure analysis EECs are somewhat different than typically produced by EFED because of the use pattern involved (residential) and the consideration of a simultaneous exposure to the parent degradates of toxicological concern. The residential exposure scenario requires PRZM/EXAMS to be run twice – once for pervious surfaces and once for impervious surfaces. The toxic equivalents (TEQ) approach requires PRZM/EXAMS to be run four times for each scenario to produce EECs for fipronil and each of three degradates. The daily time series produced by these multiple model runs are post-processed to produce a high and low residential EECs that are specific for each organism group (freshwater fish, estuarine/marine fish, etc.) that EFED typically assesses. To explore temporal variability and the likelihood of rainfall events (which can vary seasonally), the TEQ approach was run for spring, summer, and fall application dates. The fall application dates resulted in the highest exposure and are presented in Table 3 and used in risk estimation.

Table 3. Surface Water and Pore Water Fipronil TEQ Estimated Environmental Concentrations (EECs) for Proposed Perimeter Treatments in Louisiana

Proposed Label Use	PRZM/EXAMS Scenario[1]	Application Rate (application interval)	EC_{50}-Based EEC (µg ai/L)	NOAEC-Based EEC (µg ai/L)
Freshwater Fish (surface water)				
Perimeter spray	Residential – low	0.327 lb ai/A (60 days)	0.17	0.20
	Residential – high	0.327 lb ai/A (60 days)	0.34	0.40
Estuarine/Marine Fish (surface water)				
Perimeter spray	Residential – low	0.327 lb ai/A (60 days)	0.19	0.13
	Residential – high	0.327 lb ai/A (60 days)	0.41	0.25
Freshwater Invertebrates (surface water)				
Perimeter spray	Residential – low	0.327 lb ai/A (60 days)	0.14	0.11
	Residential – high	0.327 lb ai/A (60 days)	0.25	0.17
Estuarine/Marine Invertebrates (surface water)				
Perimeter spray	Residential – low	0.327 lb ai/A (60 days)	0.16	0.11
	Residential – high	0.327 lb ai/A (60 days)	0.32	0.18
Benthic Invertebrates (pore water)				
Perimeter spray	Residential – low	0.327 lb ai/A (60 days)	7.37	N/A
	Residential – high	0.327 lb ai/A (60 days)	15.31	N/A
Aquatic Vascular Plants (surface water)				
Perimeter spray	Residential – low	0.327 lb ai/A (60 days)	0.15	0.15
	Residential – high	0.327 lb ai/A (60 days)	0.27	0.27
Aquatic Non-Vascular Plants (surface water)				
Perimeter spray	Residential – low	0.327 lb ai/A (60 days)	0.15	0.16
	Residential – high	0.327 lb ai/A (60 days)	0.28	0.30
[1]O = other equipment, 100% application efficiency, 0% drift				

KABAM

The KABAM model [K_{OW} (based) Aquatic BioAccumulation Model] version 1.0 was used to evaluate potential exposure and risk via bioaccumulation and biomagnification in aquatic food webs. KABAM is used to estimate potential bioaccumulation of hydrophobic organic pesticides in freshwater aquatic ecosystems and risks to mammals and birds consuming aquatic organisms which have bioaccumulated these pesticides. The bioaccumulation portion of KABAM is based upon work by Arnot and Gobas (2004) who parameterized a bioaccumulation model based on PCBs and some pesticides (*e.g.*, lindane, DDT) in freshwater aquatic ecosystems (Arnot and Gobas, 2004). KABAM relies on a chemical's octanol-water partition coefficient (K_{OW}) to estimate uptake and elimination constants through respiration and diet of organisms in different trophic levels. Pesticide tissue residues are calculated for different levels of an aquatic food web. The model then uses pesticide tissue concentrations in aquatic animals to estimate dose- and dietary-based exposures and associated risks to mammals and birds (surrogate for amphibians and reptiles) consuming aquatic organisms. Seven different trophic levels including phytoplankton, zooplankton, benthic invertebrates, filter feeders, small-sized (juvenile) forage fish, medium-sized forage fish, and larger piscivorous fish are used to represent an aquatic food web.

Four pesticide-specific inputs are required to estimate the chemical of interest's residue concentrations in aquatic organism tissues: 1) log K_{OW}, 2) K_{OC}, 3) limnetic chemical concentration, and 4) sediment pore-water chemical concentration. The K_{OC}s and measured Log

K_{OW}s are based on registrant-submitted studies except for fipronil sulfide, which did not have a measured K_{OW} value (Table 4). The KOWWIN v1.67 program available in EPIWeb 4.1 was used to estimate a K_{OC} of 4.82 for fipronil sulfide. To determine how this modeled value for fipronil sulfide compares to a measured value, KOWWIN v1.67 estimates were generated for the other chemicals (fipronil, fipronil sulfone, and MB46513) that had measured values.

Table 4. KABAM Chemical Input Values for Fipronil and Degradates

Parameter	Fipronil	Fipronil Sulfide	Fipronil Sulfone	MB46513
Measured Log K_{OW}	3.5 (low[1]) (MRID 44350003)	N/A	3.8 (low) (MRID 44350003)	3.4 (low) (MRID 44350003)
Modeled Log K_{OW}	6.64 (high[2]) (KOWWIN v1.67)	4.82 (both[3]) (KOWWIN v1.67)	4.42 (high) (KOWWIN v1.67)	4.22 (high) (KOWWIN v1.67)
K_{OC} (mL/g)	727[4] (MRID 44039003)	3911[4] (MRID 44537902)	4208[4] (MRID 44537901)	1290[4] (MRID 44262831)
Concentration in sediment pore water (ppb)	2.1 (high) 2.9 (low)	2.3(high) 0.81 (low)	61.9 (high) 37.5 (low)	1.9 (high) 1.2 (low)
Concentration in limnetic water (ppb)	0.060 (high) 0.17 (low)	0.021 (high) 0.011 (low)	0.030 (high) 0.19 (low)	0.027 (high) 0.017 (low)

[1]Residential low exposure scenario
[2]Residential high exposure scenario
[3]The modeled fipronil sulfide log K_{OW} was used in both the low and high residential exposure scenario because there no measured value was available.
[4]Mean K_{OC} value
N/A- data not available

Chemical concentrations in pore water and the water column were based on the aforementioned high and low PRZM/EXAMS residential scenarios. Since multiple log K_{OW} estimates were available for fipronil, fipronil sulfone, and MB46513, the range of estimated K_{OW} values was incorporated into the KABAM modeling by combing the high K_{OW} values with the high residential EEC values and the low K_{OW} values with the low residential EEC values. Notice that the benthic and limnetic concentrations are occasionally higher in the low exposure scenario than in the high exposure scenario. The reason this occurs is that KABAM uses estimated pore and limnetic water concentrations that approximately match the estimated time to steady-state calculated by KABAM based on the K_{OW}. Therefore, since a high K_{OW} has a longer time to steady-state, the EEC is based on a longer averaging time, which can produce a lower EEC.

Based on the bioaccumulation model, estimated concentrations of fipronil residues in the tissue of organisms in the different trophic levels range from 5481 (phytoplankton) to 1,328,549 µg/kg (large forage fish) in the high residential exposure scenario (Table 5). None of the other scenario/chemical combinations exceed 4734 µg/kg (fipronil sulfone – medium forage fish). Example output is available in Appendix 1.

Table 5. Predicted Concentrations of Fipronil and Degradates in Aquatic Organism Tissues at Different Trophic Levels

Trophic Level	Estimated Total Concentration (µg/kg)							
	Fipronil		Fipronil Sulfide		Fipronil Sulfone		MB46513	
	High[1]	Low[2]	High[1]	Low[2]	High[1]	Low[2]	High[1]	Low[2]
Phytoplankton	5481	26	63	34	370	56	21	2
Zooplankton	10,687	19	48	25	275	41	15	1
Benthic Invertebrates	27,672	37	341	129	3413	500	76	7
Filter Feeders	18,263	24	224	85	2243	329	50	5
Small Forage Fish	92,771	48	461	174	4392	628	98	10
Medium Forage Fish	276,220	48	545	205	4734	641	103	10
Large Forage Fish	1,328,549	27	343	139	1404	92	35	2

[1]Residential high exposure scenario
[2]Residential low exposure scenario

Terrestrial Exposure

Fipronil exposure concentrations for terrestrial fauna were determined using the screening-level exposure model, T-REX (Version 1.5.2). The T-REX simulation model incorporates the nomogram relationship between the amount of pesticide applied and the amount of pesticide residue present on a given food item. Pesticide residues for each food item are calculated at a daily interval for one year using a first order decay function based on the concentrations present from both the initial and additional applications. The model assumed two applications of fipronil at 0.327 lb ai/A (equivalent to a rate of 0.0075 lb ai/1000 ft^2) each, with a 60 day application interval, and the default foliar half-life of 35 days. Upper bound Kenaga values were used for the analysis. Exposure estimates are for the parent and two of the degradates (MB 45950 and MB 46513). The third major degradate (MB46136) is not included because toxicity data indicate that it is not as toxic as the parent or the other two degradates to birds and mammals. The exposures for the degradates are adjusted by the percent of degradate that is expected to form from the parent at the specified application rate (MB 45950 = 5%; MB 46513 = 24%) (MRID 42918663) (Table 6).

Table 6. Input Parameters for the Perimeter Treatment around Man-Made Structures

	Application Rate (lbs a.i./A)	Number of Applications	Application Interval	Foliar Dissipation Half-Life
Fipronil	0.327	2	60 days	35 days
MB 45950 (5% of parent)[1]	0.016	2	60 days	35 days
MB 46513 (24% of parent)[1]	0.078	2	60 days	35 days
[1]MRID 42918663				

Avian EECs for fipronil, MB 45950, and MB 46513 are reported in Table 7. Dietary-based EECs range from 6.40 to 102.40 mg ai/kg-diet (fipronil), 0.31 to 5.01 mg ai/kg-diet (MB 45950), and 1.53 to 24.42 mg ai/kg-diet (MB 46513). Dose-based EECs range from 0.41 to 116.62 mg ai/kg-bw (fipronil), 0.02 to 5.71 mg ai/kg-bw (MB 45950), and 0.10 to 27.82 mg ai/kg-bw (MB 46513).

Table 7. Avian Estimated Environmental Concentrations for Fipronil Perimeter Treatment

Feeding Category	Dietary-based EECs (mg/kg-food item)	Dose-based EECs (mg/kg-bw)		
		Small (20 g)	Medium (100 g)	Large (1000 g)
Fipronil				
Short grass	102.40	116.62	66.50	29.77
Tall grass	46.93	53.45	30.48	13.65
Broadleaf plants	57.60	65.60	37.41	16.75
Fruits/pods	6.40	7.29	4.16	1.86
Arthropods	40.11	45.68	26.05	11.66
Seeds	6.40	1.62	0.92	0.41
MB 45950				
Short grass	5.01	5.71	3.25	1.46
Tall grass	2.30	2.62	1.49	0.67
Broadleaf plants	2.82	3.21	1.83	0.82
Fruits/pods	0.31	0.36	0.20	0.09
Arthropods	1.96	2.23	1.27	0.57
Seeds	0.31	0.08	0.05	0.02
MB 46513				
Short grass	24.42	27.82	15.86	7.10
Tall grass	11.19	12.75	7.27	3.26
Broadleaf plants	13.74	15.65	8.92	3.99
Fruits/pods	1.53	1.74	0.99	0.44
Arthropods	9.57	10.90	6.21	2.78
Seeds	1.53	0.39	0.22	0.10

Mammalian EECs for fipronil, MB 45950, and MB 46513 are reported in Table 8. Dietary-based EECs range from 6.40 to 102.40 mg ai/kg-diet (fipronil), 0.31 to 5.01 mg ai/kg-diet (MB 45950), and 1.53 to 24.42 mg ai/kg-diet (MB 46513). Dose-based EECs range from 0.22 to 97.63 mg ai/kg-bw (fipronil), 0.01 to 4.78 mg ai/kg-bw (MB 45950), and 0.05 to 23.29 mg ai/kg-bw (MB 46513).

Table 8. Mammalian Exposure Concentration Estimates for Fipronil Perimeter Treatment

Feeding Category	Dietary-based EECs (mg/kg-food item)	Dose-based EECs (mg/kg-bw)		
		Small (20 g)	Medium (100 g)	Large (1000 g)
Fipronil				
Short grass	102.40	97.63	67.47	15.64
Tall grass	46.93	44.75	30.93	7.17
Broadleaf plants	57.60	54.92	37.95	8.80
Fruits/pods	6.40	6.10	4.22	0.98
Arthropods	40.11	38.24	26.43	6.13
Seeds	6.40	1.36	0.94	0.22
MB 45950				
Short grass	5.01	4.78	3.30	0.77
Tall grass	2.30	2.19	1.51	0.35
Broadleaf plants	2.82	2.69	1.86	0.43
Fruits/pods	0.31	0.30	0.21	0.05
Arthropods	1.96	1.87	1.29	0.30
Seeds	0.31	0.07	0.05	0.01
MB 46513				
Short grass	24.42	23.29	16.09	3.73
Tall grass	11.19	10.67	7.38	1.71
Broadleaf plants	13.74	13.10	9.05	2.10
Fruits/pods	1.53	1.46	1.01	0.23
Arthropods	9.57	9.12	6.30	1.46
Seeds	1.53	0.32	0.22	0.05

EECs are calculated for honeybees (surrogate for terrestrial invertebrates) exposed to fipronil (Table 9). For adult contact exposures, the application rate (0.327 lb ai/A) is multiplied by 2.7 µg ai/bee. For adult dietary exposures, the application rate is multiplied by 110 µg ai/g and 0.29 g/day. The multipliers are based on concentrations of pesticides in pollen and nectar and the consumption rate for adult worker bees. Toxicity data are not available for larvae; consequently, EECs are not calculated for this life stage. The fipronil perimeter spray is expected to result in a complete exposure pathway for both contact and oral routes. EECs were not calculated for the two degradates because toxicity data are not available for the risk analysis.

Table 9. Terrestrial Invertebrate Contact and Dietary EECs for the Perimeter Spray

Dietary EEC (based on tall grass) (mg/kg-diet) (dose in µg ai/bee*)	Contact EEC (dose in µg ai/bee**)
10.43	0.88

Fipronil exposure concentrations for terrestrial plants were determined using the TerrPlant (version 1.2.2, 12/2006) model. TerrPlant is a Tier 1 model for screening-level assessments of pesticides that provides estimates of exposure to terrestrial plants from single pesticide applications. It derives pesticide EECs in runoff and spray drift. Risk quotients are developed for non-listed and listed species of monocots and dicots inhabiting dry and semi-aquatic areas (Appendix 2). The EECs used to evaluate potential risks to terrestrial plants are listed in Table 10.

Table 10. Terrestrial Plant EECs for Fipronil Perimeter Spray

Description	EEC (lbs ai/A)
Runoff to dry areas	0.00327
Runoff to semi-aquatic areas	0.0327
Spray drift	0.00327
Total for dry areas	0.00654
Total for semi-aquatic areas	0.03597

V. Toxicity Profile for Fipronil

The toxicity of fipronil and three of it degradates to aquatic groups is summarized in Table 11. Only the most sensitive endpoints for each taxa are reported. In some instances, endpoints were estimated (see comments column for explanations).

Table 11. Aquatic Toxicity Profile of the Most Sensitive Endpoints for Parent Fipronil and Degradates Fipronil Sulfide (MB 45950), Fipronil Sulfone (MB 46136), and MB 46513

Assessment Endpoint	Acute/ Chronic	Chemical TGAI/TEP – % ai	Species	Toxicity Value Used in Risk Assessment and Acute Toxicity Classification (If Applicable)	Citation/ MRID Classification	Comments
Freshwater fish (surrogate for aquatic-phase amphibians)	Acute	Fipronil TGAI – 100%	Bluegill sunfish (*Lepomis macrochirus*)	96-hr LC_{50} = 83 µg ai/L Very highly toxic	42918624 Acceptable	96-hr NOAEC = 43 µg ai/L (based on sublethal effects) Sublethal effects: partial/complete loss of equilibrium and lethargy
		Fipronil Sulfide (MB 45950)	NA	Assumed LC_{50} = 83 µg ai/L	NA	Assumed to be equal to the LC_{50} for parent fipronil
		Fipronil Sulfone (MB 46136) TGAI – 99.2%	Bluegill sunfish (*Lepomis macrochirus*)	96-hr LC_{50} = 25 µg ai/L Very highly toxic	42918674 Acceptable	96-hr NOAEC = 6.7 µg ai/L (based on sublethal effects) Sublethal effects: darkened pigmentation, erratic swimming behavior, partial complete loss of equilibrium, surfacing, and lethargy
		MB 46513 TGAI – 98.6%	Bluegill sunfish (*Lepomis macrochirus*)	96-hr LC_{50} = 20 µg ai/L Very highly toxic	43279702 Acceptable	96-hr NOAEC = 9.6 µg ai/L Sublethal effects: anterior extension pectoral fins, lying on the bottom of the test vessel, partial/complete loss of equilibrium, lethargy, and erratic swimming behavior
	Chronic	Fipronil TGAI – 96.7%	Rainbow trout (*Oncorhynchus mykiss*)	Early life stage 90-day NOAEC = 6.6 µg ai/L (based on reduction in larval length)	42918627 Acceptable	90-day LOAEC = 15 µg ai/L
		Fipronil Sulfide (MB 45950)	NA	Assumed NOAEC = 6.6 µg ai/L	NA	Assumed to be equal to the NOAEC for parent fipronil
		Fipronil Sulfone (MB 46136)	NA	Estimated NOAEC = 0.67 µg ai/L	NA	Estimated NOAEC using $ACR_{(rainbow\ trout)}$ for parent fipronil $= \frac{LC_{50(MB\ 46136;\ most\ sensitive\ fish\ species)}}{(LC_{50}:NOAEC_{(fipronil;\ rain\ bow\ trout)})}$ $= \frac{LC_{50(MB\ 46136;\ bluegill\ sunfish)}}{(LC_{50}:NOAEC_{(fipronil;\ rain\ bow\ trout)})}$ = 25 µg ai/L / (246 µg ai/L/6.6 µg ai/L) = 0.67 µg ai/L
		MB 46513	NA	Estimated NOAEC = 0.54 µg ai/L	NA	Estimated NOAEC using $ACR_{(rainbow\ trout)}$ for parent fipronil $= \frac{LC_{50(MB\ 46513;\ most\ sensitive\ fish\ species)}}{(LC_{50}:NOAEC_{(fipronil;\ rain\ bow\ trout)})}$ $= LC_{50(MB\ 46513;\ bluegill\ sunfish)}$

Assessment Endpoint	Acute/ Chronic	Chemical TGAI/TEP – % ai	Species	Toxicity Value Used in Risk Assessment and Acute Toxicity Classification (If Applicable)	Citation/ MRID Classification	Comments
						(LC_{50}:$NOAEC_{(fipronil;\ rain\ bow\ trout)}$) = 20 µg ai/L / (246 µg ai/L/6.6 µg ai/L) = 0.54 µg ai/L
Freshwater invertebrates	Acute	Fipronil TGAI – >98%	Black fly (*Simulium vittatum*)	LC_{50} = 0.22 µg ai/L Very highly toxic	Overmyer et al., 2005	
		Fipronil Sulfide (MB 45950) TGAI – 100%	Water flea (*Daphnia magna*)	48-hr EC_{50} = 100 µg ai/L Highly toxic	42918669 Acceptable	48-hr NOAEC < 34 µg ai/L (based on mortality) Effects: 0, 5, 10, 15, 60, 70, and 95% immobility in the negative control, solvent control, 34, 60, 100, 180, and 320 µg ai/L treatment groups; lethargy at ≥60 µg ai/L
		Fipronil Sulfone (MB 46136) TGAI – 100%	Water flea (*Daphnia magna*)	48-hr EC_{50} = 29 µg ai/L Very highly toxic	42918671 Acceptable	48-hr NOAEC < 19 µg ai/L (based on mortality and sublethal effects) Effects: 5, 5, 45, 35, 75, 90, and 100% immobility in the negative control, solvent control, 19, 31, 56, 89, and 150 µg ai/L treatment groups; lethargy and resting on the bottom
		MB 46513 TGAI – 97.8%	Water flea (*Ceriodaphnia dubia*)	LC_{50} = 43.8 µg ai/L Highly toxic	Konwick et al., 2005	
	Chronic	Fipronil	NA	Estimated NOAEC = 0.011 µg ai/L	NA	Estimated NOAEC using lowest $LC_{50(fipronil;\ FW\ invert)}$ and $ACR_{(fipronil;\ D.\ magna)}$ = $LC_{50(fipronil;\ black\ fly)}$ / $ACR_{(fipronil;\ D.\ magna)}$ = 0.22 µg ai/L / (190 µg ai/L/9.8 µg ai/L) = 0.011 µg ai/L
		Fipronil Sulfide (MB 45950)	NA	Estimated NOAEC = 0.11 µg ai/L	NA	Estimated NOAEC using lowest $LC_{50\ (MB\ 45950;\ FW\ invert)}$ and $ACR_{(fipronil;\ black\ fly)}$ =$LC_{50(MB\ 45950;\ D.\ magna)}$ / $ACR_{(fipronil;\ D.\ magna)}$ =2.13 µg ai/L / (0.22 µg ai/L/0.011 µg ai/L) =0.11 µg ai/L
		Fipronil Sulfone (MB 46136)	NA	Estimated NOAEC = 0.037 µg ai/L	NA	Estimated NOAEC using lowest $LC_{50(MB\ 46136;\ FW\ invert)}$ and $ACR_{(fipronil;\ black\ fly)}$ =$LC_{50(MB\ 46136;\ D.\ magna)}$ / $ACR_{(fipronil;\ D.\ magna)}$ =0.72 µg ai/L / (0.22 µg ai/L/0.011 µg ai/L) =0.037 µg ai/L

Assessment Endpoint	Acute/ Chronic	Chemical TGAI/TEP – % ai	Species	Toxicity Value Used in Risk Assessment and Acute Toxicity Classification (If Applicable)	Citation/ MRID Classification	Comments
		MB 46513 TGAI – 97.81%	Water flea (*Daphnia magna*)	21-day NOAEC = 41 µg ai/L (based on reduction in length and weight)	43279704 and 44812801 Acceptable	21-day NOAEC = 100 µg ai/L Other effects: reduction in survival a 260 µg ai/L
Estuarine/ marine fish	Acute	Fipronil TGAI – 96.1%	Sheepshead minnow (*Cyprinodon variegatus*)	96-hr LC_{50} = 130 µg ai/L Highly toxic	43291702 Acceptable	96-hr NOAEC < 110 µg ai/L (based on sublethal effects) Sublethal effects: erratic swimming behavior, partial/complete loss of equilibrium
		Fipronil Sulfide (MB 45950)	NA	Estimated LC_{50} = 130 µg ai/L	NA	Assumed to be equal to the LC_{50} for parent fipronil
		Fipronil Sulfone (MB 46136)	NA	Estimated LC_{50} = 21 µg ai/L	NA	Estimated LC_{50} using $LC_{50(fipronil;\ sheepshead\ minnow)}$ and largest $LC_{50(fipronil;\ FW\ fish)}$:$LC_{50(MB46136;\ FW\ fish)}$ = $LC_{50(fipronil;\ sheepshead\ minnow)}$ / $LC_{50(fipronil;\ rainbow\ trout)}$:$LC_{50(MB46136;\ rainbow\ trout)}$ = 130 µg ai/L / (246 µg ai/L/39 µg ai/L) = 21 µg ai/L
		MB 46513	NA	Estimated LC_{50} = 31 µg ai/L	NA	Estimated LC_{50} using $LC_{50(fipronil;\ sheepshead\ minnow)}$ and largest $LC_{50(fipronil;\ FW\ fish)}$:$LC_{50(MB\ 46513;\ FW\ fish)}$ = $LC_{50(fipronil;\ sheepshead\ minnow)}$ / $LC_{50(fipronil;\ bluegill\ sunfish)}$:$LC_{50(MB\ 46513;\ bluegill\ sunfish)}$ = 130 µg ai/L / (83 µg ai/L/20 µg ai/L) = 31 µg ai/L
	Chronic	Fipronil TGAI – 97.08% Radiolabeled – 99.4%	Sheepshead minnow (*Cyprinodon variegatus*)	NOAEC = 0.24 µg ai/L (based on reduction in length and weight)	446085502 Acceptable	LOAEC = 0.41 µg ai/L Other effects: reduction in egg hatching at 2.9 µg ai/L
		Fipronil Sulfide (MB 45950)	NA	Assumed NOAEC = 0.24 µg ai/L	NA	Assumed to be equal to the NOAEC for parent fipronil
		Fipronil Sulfone (MB 46136)	NA	Estimated NOAEC = 0.039 µg ai/L	NA	Estimated NOAEC using Estimated $LC_{50(MB\ 46136;\ E/M\ fish)}$ and $ACR_{(fipronil;\ sheepshead\ minnow)}$ = 21 µg ai/L / (130 µg ai/L/0.24 µg ai/L) = 0.039 µg ai/L
		MB 46513	NA	Estimated NOAEC = 0.057 µg ai/L	NA	Estimated NOAEC using Estimated $LC_{50(MB\ 46513;\ E/M\ fish)}$ and $ACR_{(fipronil;\ sheepshead\ minnow)}$ = 31 µg ai/L / (130 µg ai/L/0.24 µg ai/L) = 0.057 µg ai/L

Assessment Endpoint	Acute/ Chronic	Chemical TGAI/TEP – % ai	Species	Toxicity Value Used in Risk Assessment and Acute Toxicity Classification (If Applicable)	Citation/ MRID Classification	Comments
Freshwater sediment dwelling invertebrates	Acute	Fipronil TGAI – 98.3%	Midge (*Chironomus tentans*)	Sediment exposure <u>Sediment</u> 10-day NOAEC = 16 µg ai/kg-sediment <u>Pore water</u> 10-day NOAEC = 0.24 µg ai/L <u>Overlying water</u> 10-day NOAEC = < 0.056 µg ai/L (based on mortality)	45878001 Acceptable	<u>Sediment</u> 10-day LC_{50} = 30.7 µg ai/kg-sediment <u>Pore water</u> 10-day LC_{50} = 0.41 µg ai/L raw data not submitted for weight; study author-reported endpoint for growth (weight): 10-day EC_{50} = 50 µg ai/kg-sediment
		Fipronil Sulfide (MB 45950) TGAI – 99.5%	Midge (*Chironomus tentans*)	Sediment exposure <u>Sediment</u> 10-day NOAEC = 29 µg ai/kg-sediment <u>Pore water</u> 10-day NOAEC = 0.35 µg ai/L <u>Overlying water</u> 10-day NOAEC = 0.013 µg ai/L (based on mortality)	45084801 Acceptable	<u>Sediment</u> 10-day NOAEL = 54 µg ai/kg-sediment (based on growth) 10-day EC_{50} = 50.9 µg ai/kg-sediment (based on growth) 10-day LC_{50} = 116.9 µg ai/kg-sediment <u>Pore water</u> 10-day NOAEL = 0.94 µg ai/L (based on growth) 10-day EC_{50} = 0.66 µg ai/L (based on growth) 10-day LC_{50} = 2.13 µg ai/L <u>Overlying water</u> 10-day NOAEL = 0.022 µg ai/L (based on growth)
		Fipronil Sulfone	Midge	Sediment exposure	45175901	<u>Sediment</u>

Assessment Endpoint	Acute/ Chronic	Chemical TGAI/TEP – % ai	Species	Toxicity Value Used in Risk Assessment and Acute Toxicity Classification (If Applicable)	Citation/ MRID Classification	Comments
		(MB 46136) TGAI – 99.01%	(*Chironomus tentans*)	<u>Sediment</u> 10-day NOAEC = 9.1 µg ai/kg-sediment <u>Pore water</u> 10-day NOAEC = 0.073 µg ai/L <u>Overlying water</u> 10-day NOAEC = 0.0052 µg ai/L (based on growth)	Acceptable	10-day EC_{50} = 34.8 µg ai/kg-sediment (based on growth) 10-day NOAEL = 14 µg ai/kg-sediment (based on mortality) 10-day LC_{50} = 44.8 µg ai/kg-sediment <u>Pore water</u> 10-day EC_{50} = 0.41 µg ai/L (based on growth) 10-day NOAEL = 0.30 µg ai/L (based on mortality) 10-day LC_{50} = 0.72 µg ai/L <u>Overlying water</u> 10-day NOAEL = 0.0069 µg ai/L (based on mortality)
		MB 46513 TGAI – 97.8% Radiolabeled – 99.1-99.6%	Midge (*Chironomus tentans*)	Sediment exposure <u>Sediment</u> 10-day NOAEC = < 185 µg ai/kg-sediment (based on growth)	45375901 Supplemental (due to unreliable pore water concentrations)	<u>Sediment</u> 10-day EC_{50} = 520 µg ai/kg-sediment (based on growth) 10-day NOAEL = 185 µg ai/kg-sediment (based on mortality) 10-day LC_{50} = 1300 µg ai/kg-sediment

Assessment Endpoint	Acute/ Chronic	Chemical TGAI/TEP – % ai	Species	Toxicity Value Used in Risk Assessment and Acute Toxicity Classification (If Applicable)	Citation/ MRID Classification	Comments
	Chronic	MB 45950 Radiolabeled – 99.5%	Midge (*Chironomus riparius*)	<u>Sediment</u> 28-day NOAEC = 1.85 µg TTR/kg-dw sediment <u>Overlying water</u> 28-day NOAEC = 0.015 µg TTR/L (based on emergence and development rates)	45851001 Supplemental (non-guideline)	NOAEC = 1.1* µg/kg-dw sediment (day -10 conc.) (based on lethargy) *may be an overestimated NOAEC as the concentration was not measured on days 0 and 28 at this treatment level
Estuarine/ marine invertebrates	Acute	Fipronil TGAI – 96.1%	Mysid shrimp (*Americamysis bahia*)	96-hr LC_{50} = 0.140 µg ai/L Very highly toxic	43279701 Acceptable	96-hr NOAEC < 62 µg ai/L
		Fipronil Sulfide (MB 45950) TGAI – 99.7%	Mysid shrimp (*Americamysis bahia*)	96-hr LC_{50} = 0.077 µg ai/L Very highly toxic	45156302 Acceptable	96-hr NOAEC = 33 µg ai/L Sublethal effects: None
		Fipronil Sulfone (MB 46136) TGAI – 99.7%	Mysid shrimp (*Americamysis bahia*)	96-hr LC_{50} = 0.056 µg ai/L Very highly toxic	45165301 Acceptable	96-hr NOAEC = 0.031 µg ai/L Sublethal effects: None
		MB 46513 TGAI – 97.8%	Mysid shrimp (*Americamysis bahia*)	96-hr LC_{50} = 1.5 µg ai/L Very highly toxic	45120001 Acceptable	96-hr NOAEC = 0.66 µg ai/L
		Fipronil TGAI – 96.1%	Eastern oyster (*Crassostrea virginica*)	96-hr EC_{50} = 770 µg ai/L Highly toxic	43291701 Acceptable	Sublethal effects: reduced fecal and pseudofecal production at 1.2 µg ai/L
	Chronic	Fipronil TGAI – 97.7%	Mysid shrimp (*Americamysis bahia*)	28-day NOAEC < 0.005 µg ai/L (based on reduction in male weight)	43681201 Supplemental (due to lack of a NOAEC)	28-day LOAEC = <0.005 µg ai/L Other effects: reduction in male length at ≥15 µg ai/L; reduction in female weight and length at 57 and ≥28 µg ai/L, respectively; reduction in reproduction and F1 survival at 57 µg ai/L
		Fipronil Sulfide	Mysid shrimp	28-day NOAEC = 0.0046 µg	45259202	28-day LOAEC = 0.0087 µg ai/L

Assessment Endpoint	Acute/ Chronic	Chemical TGAI/TEP – % ai	Species	Toxicity Value Used in Risk Assessment and Acute Toxicity Classification (If Applicable)	Citation/ MRID Classification	Comments
		(MB 45950) TGAI – 99.5%	(*Americamysis bahia*)	ai/L (based on reduction in male weight)	Supplemental (due to the lack of a solvent control)	Other effects: reduction in reproduction, F1 survival, male length and female weight at 35 µg ai/L
		Fipronil Sulfone (MB 46136) TGAI – 99%	Mysid shrimp (*Americamysis bahia*)	28-day NOAEC < 0.0026 µg ai/L (based on reduction in female weight)	45259203 Supplemental (due to the lack of a NOAEC and solvent control)	28-day LOAEC = 0.0026 µg ai/L Other effects: reduction in male weight at ≥9.3 µg ai/L; reduction in reproduction and male length at ≥19 µg ai/L
		MB 46513	NA	Estimated NOAEC = 0.054 µg ai/L	NA	Estimated NOAEC using lowest $LC_{50(MB\ 46513;\ SW\ invert)}$ and $ACR_{(fipronil;\ A.\ bahia)}$ = $LC_{50(MB\ 46513;\ A.\ bahia)}$ / $ACR_{(fipronil;\ A.\ bahia)}$ = 1.5µg ai/L / (0.140 µg ai/L/0.005µg ai/L) = 0.054µg ai/L
Aquatic plants	Vascular	Fipronil TGAI – 96.1%	Duckweed (*Lemna gibba*)	14-day EC_{50} > 100 µg ai/L 14-day NOAEC = 100 µg ai/L (based on number of fronds and dry weight)	42918656 Acceptable	
		Fipronil Sulfide (MB 45950)	NA	Assumed EC_{50} > 100 µg ai/L Assumed NOAEC = 100 µg ai/L	NA	Assumed to be equal to the EC_{50} and NOAEC for parent fipronil
		Fipronil Sulfone (MB 46136)	NA	Assumed EC_{50} > 100 µg ai/L Assumed NOAEC = 100 µg ai/L	NA	Assumed to be equal to the EC_{50} and NOAEC for parent fipronil
		MB 46513	NA	Assumed EC_{50} > 100 µg ai/L Assumed NOAEC = 100 µg ai/L	NA	Assumed to be equal to the EC_{50} and NOAEC for parent fipronil
	Non-vascular	Fipronil TGAI – 96.1%	Freshwater diatom (*Navicula pelliculosa*)	5-day EC_{50} > 120 µg ai/L 5-day NOAEC = 120 µg ai/L (based on cell density)	42918658 Acceptable	
		Fipronil Sulfide (MB 45950)	NA	Assumed EC_{50} > 120 µg ai/L Assumed NOAEC = 120 µg	NA	Assumed to be equal to the EC_{50} and NOAEC for parent fipronil

Assessment Endpoint	Acute/ Chronic	Chemical TGAI/TEP – % ai	Species	Toxicity Value Used in Risk Assessment and Acute Toxicity Classification (If Applicable)	Citation/ MRID Classification	Comments
				ai/L		
		Fipronil Sulfone (MB 46136)	NA	Assumed EC_{50} > 120 µg ai/L Assumed NOAEC = 120 µg ai/L	NA	Assumed to be equal to the EC_{50} and NOAEC for parent fipronil
		MB 46513 TGAI – 98.6%	Green alga (*Selenastrum capricornutum*)	5-day EC_{50} = 76 µg ai/L 5-day EC_{05} = 7.5 µg ai/L (based on cell density)	43279705 Acceptable	Effects: Statistically-significant reductions in cell density at all concentrations tested; 5-day NOAEC < 12 µg ai/L

The toxicity of fipronil and degradates MB 45950 and MB 46136 to terrestrial taxa are reported in Table 12. Quantitative data for honeybees were not available; however, some qualitative data were available from the open literature. Mayer and Lunden (1999) (ECOTOX #62630) determined contact 24-hr LD_{50}s for three species of bees: alkali bee (*Nomia melanderi*), honeybee (*Apis mellifera*), and alfalfa leafcutter bee (*Megachile rotundata*). The corresponding LD_{50}s were 1.130 µg ai/bee for the alkali bee, 0.013 µg ai/bee for the honeybee, and 0.004 µg ai/bee for the alfalfa leafcutter bee. A second study, Oliveira Jacob *et al.* (2013), calculated a contact (24-hr LD_{50} = 0.54 ng ai/bee) and dietary (24-hr LC_{50} = 0.24 ng ai/µL-diet) toxicity endpoint for the stingless bee (*Scaptotrigona postica*). Neither study used a negative control, although both studies had solvent (acetone) controls. Mortality data for the solvent control was not reported; thus these studies can only be used qualitatively to characterize the toxicity of fipronil to terrestrial invertebrates.

Table 12. Terrestrial Toxicity Profile for Parent Fipronil and Degradates Fipronil Sulfide (MB 45950), Fipronil Sulfone (MB 46136), and MB 46513

Assessment Endpoint	Acute/ Chronic	Chemical TGAI/TEP – % ai	Species	Toxicity Value Used in Risk Assessment and Acute Toxicity Classification (If Applicable)	Citation or MRID # Classification	Comment
Birds (surrogate for terrestrial-phase amphibians and reptiles)	Acute single oral dose	Fipronil TGAI – 96%	Bobwhite quail (*Colinus virginianus*)	21-day LD_{50} = 11.3 mg ai/kg-bw Highly toxic	42918617 Acceptable	21-day NOAEL < 1 mg ai/kg-bw (based on reduction in food consumption during the first 3 days) Sublethal effects: at ≥4.64 mg ai/kg-bw, lethargy, moving the head from side to side when disturbed, chalky diarrhea, anorexia, stumbling, ataxia, tremors, tachypnea, wing-beat convulsions, tetany, spasms, loss of balance, piloerection, sitting, failure to respond to external stimuli, gasping for breath, noticeable weight loss, the appearance of weakness or listlessness, and death; remission achieved by day 18; reduction in body weight at 4.46 and 10 mg ai/kg-bw on days 3, 7, and 14; reductions in body weight before death at 21.5 and 46.4 mg ai/kg-bw; dose-dependent reduction in food consumption during the first 3 days of the test for all treatment groups; reduction in food consumption continued through day 7 at 4.64 mg ai/kg-bw and through day 14 at 10 and 21.5 mg ai/kg-bw
		Fipronil Sulfide (MB 45950)	NA	Estimated LD_{50} = 26.8 mg ai/kg-bw	NA	Estimated LD_{50} using $Acute_{(oral)}$-to-$Acute_{(dietary)}$ Ratio = LD_{50}:$LC_{50(\text{most sensitive avian species})}$*$LC_{50(\text{MB 45960})}$ = LD_{50}:$LC_{50(\text{bobwhite quail})}$*$LC_{50(\text{MB 45960})}$ = (11.3 mg a.i./kg-bw/48 mg ai/kg-diet)*114 mg ai/kg-diet = 26.8 mg ai/kg-bw
		Fipronil Sulfone (MB 46136)	NA	Estimated LD_{50} = 19.7 mg ai/kg-bw	NA	Estimated LD_{50} using $Acute_{(oral)}$-to-$Acute_{(dietary)}$ Ratio = LD_{50}:$LC_{50(\text{most sensitive avian species})}$*$LC_{50(\text{MB 45960})}$ = LD_{50}:$LC_{50(\text{bobwhite quail})}$*$LC_{50(\text{MB 43136})}$ = (11.3 mg ai/kg-bw/48 mg ai/kg-diet)*84 mg ai/kg-diet = 19.7 mg ai/kg-bw
		MB 46513 TGAI – 98.6%	Bobwhite quail (*Colinus virginianus*)	21-day LD_{50} = 5 mg ai/kg-bw Highly toxic	43776601 Acceptable	21-day NOAEL = 3.16 mg ai/kg-bw (based on a reduction in body weight) Sublethal effects: reduction in feed consumption at ≥ 3.16 mg a.i./kg-bw; reduction in body weight on day 7 at ≥14.7 mg a.i./kg-bw

Assessment Endpoint	Acute/ Chronic	Chemical TGAI/TEP – % ai	Species	Toxicity Value Used in Risk Assessment and Acute Toxicity Classification (If Applicable)	Citation or MRID # Classification	Comment
	Sub-acute dietary	Fipronil TGAI – >95%	Bobwhite quail (*Colinus virginianus*)	21-day* = 48 mg ai/kg-diet *5-day exposure; 17-day post-exposure observation Very highly toxic	42918620 Acceptable	21-day NOAEC = 19 mg ai/kg-diet (based on mortality and sublethal effects) Sublethal effects: lethargy, white-colored diarrhea, and anorexia at ≥39 mg ai/kg-diet (remission of survivors at 39 mg ai/kg-diet by end of day 6); reduction in body weight on day 22 at 39 mg ai/kg-diet
		Fipronil Sulfide (MB 45950) TGAI – 98.8%	Bobwhite quail (*Colinus virginianus*)	8-day LC_{50} = 114 mg ai/kg-diet Highly toxic	44890302 Acceptable	8-day NOAEC = 17.8 mg ai/kg-diet (based on sublethal effects) Effects: 0, 0, 10, 0, 0, 30, 100% mortality in the control, 10.0, 17.8, 31.6, 56.2, 100 and 178 mg ai/kg-diet treatment groups; ruffled appearance, wing droop, lethargy, depression, reduced reaction to external stimuli, convulsion, shallow and rapid respiration, and loss of coordination at ≥31.6 mg ai/kg-diet; dose-dependent reduction in body weight gain at 56.2 and 100 mg ai/kg-diet; treatment-related reduction in food consumption at ≥100 mg ai/kg-diet
		Fipronil Sulfone (MB 46136) TGAI – 99.7%	Bobwhite quail (*Colinus virginianus*)	8-day LC_{50} = 84 mg ai/kg-diet Highly toxic	44890301 Acceptable	8-day NOAEC = 17.8 mg ai/kg-diet (based on sublethal effects) Sublethal effects: ruffled appearance, wing droop, lethargy, convulsions, reduced reaction to external stimuli, lower limb weakness, loss of coordination and protracted posture at ≥ 31.6 mg ai/kg-diet; dose-dependent reduction in body weight gain at 56.2 mg ai/kg-diet and weigh loss at ≥100 mg ai/kg-diet
		MB 46513 TGAI – 97.8	Bobwhite quail (*Colinus virginianus*)	8-day LC_{50} = 119.2 mg ai/kg-diet Highly toxic	45259201 Acceptable	8-day NOAEC < 18.6 mg ai/kg-diet (based on sublethal effect of body weight gain between days 0 and 5) Sublethal effects: dose-dependent reduction in body weight gain or loss from days 0 to 5 at treatment levels where total mortality did not occur (*i.e.*, 18.6-49.3 mg ai/kg-diet); reduction in feed consumption from days 0 to 5 at 126 mg ai/kg-diet; ruffled appearance, lethargy, wing droop, loss of coordination, tremors, reduced response to stimuli at ≥49.3 mg ai/kg-diet

Assessment Endpoint	Acute/ Chronic	Chemical TGAI/TEP – % ai	Species	Toxicity Value Used in Risk Assessment and Acute Toxicity Classification (If Applicable)	Citation or MRID # Classification	Comment
	Chronic	Fipronil TGAI – 96.7%	Bobwhite quail (*Colinus virginianus*)	142-day NOAEC = 10 mg ai/kg-diet (no treatment-related effects)	42918622 Supplemental (due to no effects at concentrations tested)	142-day LOAEC > 10 mg ai/kg-diet Effects: statistically-significant increases in cracked eggs and decreases in male body weight at 0.2 and 2 mg ai/kg-diet were not considered treatment-related because there was no effect at 10 mg ai/kg-diet
		Fipronil Sulfide (MB 45950)	NA	Assumed NOAEC = 10 mg ai/kg-diet	NA	Assumed to be equal to the NOAEC for parent fipronil
		Fipronil Sulfone (MB 46136)	NA	Assumed NOAEC = 10 mg ai/kg-diet	NA	Assumed to be equal to the NOAEC for parent fipronil
		MB 46513	NA	Assumed NOAEC = 10 mg ai/kg-diet	NA	Assumed to be equal to the NOAEC for parent fipronil
Mammals	Acute single oral dose	Fipronil TGAI – 93%	Rat	<u>Combined sexes</u> 15-day LD_{50} = 97 mg ai/kg-bw <u>Males</u> 15-day LD_{50} = 92 mg ai/kg-bw <u>Females</u> 15-day LD_{50} = 103 mg ai/kg-bw Moderately toxic	42918628	Sublethal effects: pilo-erection, diarrhea, abnormal body carriage (hunched posture), and abnormal gait (waddling) at ≥50 mg/kg-bw; lethargy at ≥80 mg/kg-bw; decreased respiratory rate in1 male at 80 mg/kg-bw and all individuals at 200 mg/kg-bw; ptosis, pallor of extremities, clonic convulsions, and prostrate stature at 200 mg ai/kg-bw; low body weight gain on day 8 for up to 2 females at each treatment level and for all males surviving treatment; with the exception of one female at 50 mg/kg which showed a slightly low body weight gain, all survivors achieved anticipated body weight gains by study termination
		Fipronil Sulfide (MB 45950)	Rat	LD_{50} = 83 mg ai/kg-bw Moderately toxic	HED memo[a]	
		Fipronil Sulfone (MB 46136) TGAI – 98%	Rat	LD_{50} = 218 mg/kg-bw Moderately toxic	42918675	
		MB 46513	Rat	LD_{50} = 16 mg ai/kg-bw Highly toxic	43235402	
	Chronic	Fipronil	Rat	<u>Reproductive</u> NOAEL = 2.5 mg ai/kg-bw/day	42918647	<u>Parental/Systemic</u> NOAEL = 0.25 mg ai/kg-bw/day

Assessment Endpoint	Acute/ Chronic	Chemical TGAI/TEP – % ai	Species	Toxicity Value Used in Risk Assessment and Acute Toxicity Classification (If Applicable)	Citation or MRID # Classification	Comment
				NOAEC = 30 mg ai/kg-diet (based on clinical signs, decreased litter size, decreased body weight, decreased mating, decreased fertility index, decreased post-implant survival and offspring postnatal survival, and delayed physical development)		LOAEL = 2.5 mg ai/kg-bw/day (based on: male/female increased thyroid and liver weights, and female decreased pituitary weight and increased follicular epithelial hypertrophy) <u>Reproductive</u> LOAEL = 26 mg ai/kg-bw/day <u>Offspring</u> NOAEL = 26 mg ai/kg-bw/day LOAEL = >26 mg ai/kg-bw/day
		Fipronil Sulfide (MB 45950)	NA	NOAEL = 2.5 mg ai/kg-bw/day NOAEC = 30 mg ai/kg-diet	NA	Assumed to be equal to the NOAEC for parent fipronil
		Fipronil Sulfone (MB 46136)	NA	NOAEL = 2.5 mg ai/kg-bw/day NOAEC = 30 mg ai/kg-diet	NA	Assumed to be equal to the NOAEC for parent fipronil
		MB 46513	NA	NOAEL = 2.5 mg ai/kg-bw/day NOAEC = 30 mg ai/kg-diet	NA	Assumed to be equal to the NOAEC for parent fipronil
Terrestrial plants	Seedling emergence	Fipronil TGAI – 80.3%	Oat (*Avena sativa*) Oilseed rape (*Brassica napus*)	<u>Monocot (oat)</u> EC25: 3.49 mg a.i./kg-dry soil (7.1 lb ai/A) EC05: 0.00563 mg a.i./kg-dry soil (0.011 lb ai/A) NOEC: <0.125 mg a.i./kg-dry soil Based on wet weight <u>Dicot (oilseed rape)</u> EC25: 2.27 mg a.i./kg-dry soil (4.62 lb ai/A) NOEC: 0.5 mg a.i./kg-dry soil (1.02 lb ai/A) Based on wet weight	48599701 Supplemental (subset of required species were tested and monocot NOAEC not established)	

[a] Fipronil - Review of toxicity studies (28-day studies with fipronil and metabolite RPA 200766, a developmental neurotoxicity study with fipronil and a paper on the toxicological significance of fipronil and its metabolites). From V.A. Dobozy (Registration Branch 1/HED) to M. Johnson (RD), 8/6/1997

VI. Risk Estimation

Risk to Aquatic Taxa

Acute non-listed species LOCs (0.5) were exceeded for all aquatic invertebrates (freshwater, benthic, and estuarine/marine). Chronic RQs exceeded the listed and non-listed species LOC (1) for estuarine/marine fish (high exposure scenario only) and freshwater invertebrates. Chronic risk quotients could not be calculated for estuarine/marine invertebrates because the toxicity data were non-definitive. In lieu of this, the toxicity value (<0.005 µg ai/L) was compared directly with the NOAEC-based EECs for estuarine/marine invertebrates (0.11 and 0.18 µg ai/L). Given that the EECs are higher than 0.005 µg ai/L, risk concerns are likely for estuarine/marine invertebrates. Likewise, definitive data were not available for non-listed aquatic vascular plants (>100 µg ai/L) and non-listed non-vascular aquatic plants (>120 µg ai/L). When compared directly with the EECs (vascular aquatic: 0.15 to 0.27 µg ai/L; non-vascular aquatic: 0.15 to 0.28 µg ai/L); the EECs are several order of magnitude lower than the toxicity values. Consequently, risk concerns for aquatic vascular and non-vascular plants are not expected. For benthic invertebrates, chronic toxicity data were not available. Given that chronic risk concerns were identified for both freshwater and estuarine/marine invertebrates, chronic risk is assumed for benthic invertebrates as well.

In summary, risk concerns were identified for estuarine/marine fish (chronic only), freshwater invertebrates, estuarine/marine invertebrates, and benthic invertebrates. Risk concerns were not identified for freshwater fish, estuarine/marine fish (acute only), vascular aquatic plants, and non-vascular aquatic plants (Table 13 and 14).

Table 13. Acute and Chronic Risk Quotients for Aquatic Taxa (Excluding Plants)

Scenario	EC_{50} or LC_{50} (µg ai/L)	NOAEC (µg ai/L)	EC_{50} or LC_{50}-based EEC (µg ai/L)	NOAEC-based EEC (µg ai/L)	Acute RQ	Chronic RQ
Freshwater fish (surface water)						
Residential – low	83	6.6	0.17	0.20	0.002	0.03
Residential – high	83	6.6	0.34	0.40	0.004	0.06
Estuarine/marine fish (surface water)						
Residential – low	130	0.24	0.19	0.13	0.001	0.54
Residential – high	130	0.24	0.41	0.25	0.003	**1.04*** **
Freshwater invertebrates (surface water)						
Residential – low	0.22	0.011	0.14	0.11	**0.64****	**10*** **
Residential – high	0.22	0.011	0.25	0.17	**1.14****	**15.5*** **
Estuarine/marine invertebrates (surface water)						
Residential – low	0.140	<0.005	0.16	0.11	**1.14****	ND
Residential – high	0.140	<0.005	0.32	0.18	**2.29****	ND

Scenario	EC_{50} or LC_{50} (µg ai/L)	NOAEC (µg ai/L)	EC_{50} or LC_{50}-based EEC (µg ai/L)	NOAEC-based EEC (µg ai/L)	Acute RQ	Chronic RQ
Freshwater benthic organisms (pore water)						
Residential – low	0.24	N/A	2.84	N/A	**33.5****	N/A
Residential – high	0.24	N/A	4.69	N/A	**69.6****	N/A

N/A – chronic toxicity data were not available for EEC calculation and RQ derivation
ND – data were non-definitive and a RQ could not be calculated
* Exceeds acute listed species LOC (0.05)
** Exceeds acute non-listed species LOC (0.5)
*** Exceeds chronic LOC (1.0)

Table 14. Acute and Chronic Risk Quotients for Aquatic Plants

Scenario	EC_{50} or LC_{50} (µg ai/L)	NOAEC (µg ai/L)	EC_{50} or LC_{50}-based EEC (µg ai/L)	NOAEC-based EEC (µg ai/L)	Listed Species RQ	Non-Listed Species RQ
Vascular aquatic plants (surface water)						
Residential – low	>100	100	0.15	0.15	ND	0.002
Residential – high	>100	100	0.27	0.27	ND	0.003
Non-vascular plants (surface water)						
Residential – low	>120	120	0.15	0.16	ND	0.001
Residential – high	>120	120	0.28	0.30	ND	0.003

ND – data were non-definitive and a RQ could not be calculated

Risk to Terrestrial Taxa

Avian risk is used as a surrogate for reptiles and terrestrial-phase amphibians. Avian risk quotients were above the acute listed and non-listed species LOC (0.1) for most avian size classes and diets for fipronil and the MB 46513 degradate. Acute concerns for listed species were also identified for the MB 45950 degradate, but they were limited to 20 and 100 g birds. Chronic risk concerns were identified for fipronil and the MB 46513 degradate; the MB 45950 analysis did not identify chronic risk concerns. Overall, acute and chronic risk concerns were identified for birds, reptiles, and terrestrial-phase amphibians for the proposed fipronil perimeter treatment (Table 15). See Appendix 3 for T-REX input.

Table 15. Summary of Avian Risk Quotients (RQ) for Fipronil Perimeter Treatment

Risk Quotients Based on Kenaga Upper Bound EEC	Dose-Based RQs			Dietary-Based RQs	
	20 g	100 g	1000 g	Acute	Chronic
	Acute	Acute	Acute		
Fipronil					
Short grass	**14.33****	**6.42****	**2.03****	**2.13****	**10.24*****
Tall grass	**6.57****	**2.94****	**0.93****	**0.98****	**4.69*****
Broadleaf plants	**8.06****	**3.61****	**1.14****	**1.20****	**5.76*****
Fruits/pods	**0.90****	**0.40***	**0.13***	**0.13***	0.64
Arthropods	**5.61****	**2.51****	**0.80****	**0.84****	**4.01*****
Seeds	**0.20***	0.09	0.03	**0.13***	0.64
MB 45950					
Short grass	**0.30***	**0.13***	0.04	0.04	0.50
Tall grass	**0.14***	0.06	0.02	0.02	0.23
Broadleaf plants	**0.17***	0.07	0.02	0.02	0.28
Fruits/pods	0.02	0.01	<0.01	<0.01	0.03
Arthropods	**0.12***	0.05	0.02	0.02	0.20
Seeds	<0.01	<0.01	<0.01	<0.01	0.03
MB 46513					
Short grass	**7.72****	**3.46****	**1.10****	**0.20***	**2.44*****
Tall grass	**3.54****	**1.59****	**0.50****	0.09	**1.12*****
Broadleaf plants	**4.34****	**1.95****	**0.62****	**0.12***	**1.37*****
Fruits/pods	**0.48***	**0.22***	0.07	0.01	0.15
Arthropods	**3.02****	**1.35****	**0.43***	0.08	0.96
Seeds	**0.11***	0.05	0.02	0.01	0.15

* Exceeds listed species acute toxicity LOC (0.1)
**Exceeds non-listed species acute LOC (0.5)
***Exceeds chronic LOC (1.0)

Mammalian RQs were above the acute listed species LOC (0.1) and chronic LOC (1) for all size classes and most food items for fipronil. Degradate MB 46513 followed a similar pattern, but the RQ for small and medium mammals consuming short grass was above the non-listed species LOC (0.5) as well. Degradate MB 45950 did not have acute RQs above the LOC, but the analysis identified chronic risk concerns for degradate MB 45950 for all size classes of mammals for most food items. Overall, the RQs indicated acute and chronic risks for listed and non-listed species (Table 16).

Table 16. Summary of Mammalian Risk Quotients (RQ) for Fipronil Perimeter Treatment

Risk Quotients Based on Kenaga Upper Bound EEC	Dose-Based RQs						Dietary-Based RQs
	15 g		35 g		1000 g		
	Acute	Chronic	Acute	Chronic	Acute	Chronic	Chronic
Fipronil							
Short grass	**0.46***	**355.36*****	**0.39***	**303.55*****	**0.21***	**162.71*****	**40.96*****
Tall grass	**0.21***	**162.87*****	**0.18***	**139.13*****	**0.10***	**74.58*****	**18.77*****
Broadleaf plants	**0.26***	**199.89*****	**0.22***	**170.74*****	**0.12***	**91.53*****	**23.04*****
Fruits/pods	0.03	**22.21*****	0.02	**18.97*****	0.01	**10.17*****	**2.56*****
Arthropods	**0.18***	**139.18*****	**0.15***	**118.89*****	0.08	**63.73*****	**16.04*****
Seeds	0.01	**4.94*****	0.01	**4.22*****	<0.01	**2.26*****	**2.56*****
MB 45950							
Short grass	0.03	**17.39*****	0.02	**14.85*****	0.01	**7.96*****	**2.00*****
Tall grass	0.01	**7.97*****	0.01	**6.81*****	0.01	**3.65*****	0.92
Broadleaf plants	0.01	**9.78*****	0.01	**8.35*****	0.01	**4.48*****	**1.13*****
Fruits/pods	<0.01	**1.09*****	<0.01	0.93	<0.01	0.50	0.13
Arthropods	0.01	**6.81*****	0.01	**5.82*****	<0.01	**3.12*****	0.78
Seeds	<0.01	0.24	<0.01	0.21	<0.01	0.11	0.13
MB 46513							
Short grass	**0.66****	**84.76*****	**0.57****	**72.41*****	**0.30***	**38.81*****	**9.77*****
Tall grass	**0.30***	**38.85*****	**0.26***	**33.19*****	**0.14***	**17.79*****	**4.48*****
Broadleaf plants	**0.37***	**47.68*****	**0.32***	**40.73*****	**0.17***	**21.83*****	**5.50*****
Fruits/pods	0.04	**5.30*****	0.04	**4.53*****	0.02	**2.43*****	0.61
Arthropods	**0.26***	**33.20*****	**0.22***	**28.36*****	**0.12***	**15.20*****	**3.83*****
Seeds	0.01	**1.18*****	0.01	**1.01*****	<0.01	0.54	0.61

* Exceeds listed species acute toxicity LOC (0.1)
** Exceeds non-listed species acute LOC (0.5)
*** Exceeds chronic LOC (1.0)

Risk to Terrestrial Invertebrates

Risk quotients could not be calculated for terrestrial invertebrates for the expanded fipronil perimeter use because toxicity data were not available. Some acute oral and contact toxicity data were available from the open literature; however, the data are limited in their reliability because control mortality information was not provided in the publications. In spite of this, the data can be used to qualitatively compare with the EECs that were generated to provide a general idea of risk. Contact 24-hr LD_{50}s were 0.00054 (stingless bee), 0.013 (honeybee), 0.004 (alfalfa leafcutter bee), and 1.130 µg ai/bee (alkali bee) (Oliveira Jacob *et al.* 2013; Mayer and Lunden 1999). The contact toxicity EEC for the perimeter spray is 0.88 µg ai/bee. This is three orders of magnitude higher than the toxicity value for the most sensitive bee (stingless bee). For dietary exposures, the LC_{50} of the stingless bee is 0.24 ppm. The perimeter spray dietary EEC is predicted as 35.97 ppm (10.43 µg ai/bee divided by 0.292 g food consumed/day), which is several orders of magnitude higher than the toxicity value. This toxicity information suggests that the perimeter spray may present direct risk concerns for terrestrial invertebrates.

Risk to Terrestrial Plants

The LOC (1) was exceeded for listed semi-aquatic monocots. This indicates a potential risk concern for monocots. One caveat is that an EC_{05} was used instead of a NOAEC because a NOAEC could not be calculated from the Agency's only terrestrial plant study (MRID 48599701). The EC_{05} is likely a more conservative value than the NOAEC (Table 17).

Table 17. Risk Quotient Values for Plants in Dry and Semi-Aquatic Areas Exposed to Fipronil through Runoff and/or Spray Drift

Plant Type	Listed Status	Dry	Semi-Aquatic	Spray Drift
Monocot	non-listed	<0.1	<0.1	<0.1
Monocot	listed	0.59	**3.27*** **	0.30
Dicot	non-listed	<0.1	<0.1	<0.1
Dicot	listed	<0.1	<0.1	<0.1

***Exceeds the LOC (1).**

Risk from Bioaccumulation

Bioaccumulation is strongly dependent upon the K_{OW} of the chemical. The high K_{OW} values for fipronil, fipronil sulfone, and MB46513 as well as the only value available for fipronil sulfide are model estimates (KOWWIN v1.67 implemented in EPIWEB 4.1). The low K_{OW} values for fipronil, fipronil sulfone, and MB46513 are measured from registrant-submitted studies using an HPLC method. HPLC is the preferred method for chemicals with high K_{OW}s. The quality of the HPLC results depends on the number of reference compounds used, the certainty of the K_{OW}s for those reference compounds, the appropriateness of the selected compounds (does the K_{OW} of the unknown compound fall within the range of K_{OW}s of the references), and the fit of the calibration curve to those reference compounds. EFED cannot judge the certainty of the K_{OW}s for the reference compounds because studies were not provided for the individual reference compounds, but the other aspects of these studies were acceptable. Therefore, EFED believes the measured (low) K_{OW} estimates are more reflective of the bioaccumulation potential of fipronil.

Tables 18 to 21 report the range of RQs (low EEC scenario plus low Kow; high EEC scenario plus high Kow) for fipronil and its degradates. Many of the RQs for fipronil exceed acute and chronic LOCs for the high scenario. Fipronil sulfone also has two scenarios that exceed the acute listed species LOC and the chronic LOC for the high scenario. Given that the Kows from the actual studies are probably more accurate than the higher ones predicted by the KOWWIN program, more weight should be given to the low RQ estimates than the high ones. Consequently, risk concerns are probably low for the bioaccumulation exposure pathway.

Table 18. Bioaccumulation Risk Quotients for Mammals, Birds, Reptiles, and Amphibians Consuming Fish Contaminated by Fipronil

Wildlife Species	Acute		Chronic	
	Dose Based	Dietary Based	Dose Based	Dietary Based
Mammalian				
fog/water shrew	<0.001 – 0.084	N/A	0.007 – **5.14*****	0.001 – 0.922
rice rat/star-nosed mole	<0.001 – **0.017***	N/A	0.008 – **10.43*****	0.001 – **1.54*****
small mink	<0.001 - **0.938****	N/A	0.010 – **57.51*****	0.002 – **9.21*****
large mink	<0.001 – **1.04****	N/A	0.011 – **63.55*****	0.002 – **9.21*****
small river otter	<0.001 – **1.12****	N/A	0.012 – **68.40*****	0.002 – **9.21*****
large river otter	<0.001 – **5.81****	N/A	0.007 – **356.1*****	0.001 – **44.29*****
Avian				
sandpipers	0.005 – **5.93****	0.001 – **0.973****	N/A	0.004 – **4.67*****
cranes	<0.001 – **0.761****	0.001 – **2.27****	N/A	0.004 – **10.91*****
rails	0.002 – **3.54****	0.001 – **1.26****	N/A	0.004 – **6.02*****
herons	<0.001 – **1.39****	0.001 – **3.17****	N/A	0.004 – **15.20*****
small osprey	0.001 – **3.64****	0.001 – **5.76****	N/A	0.005 – **27.62*****
white pelican	<0.001 – **7.16****	0.001 – **27.68****	N/A	0.003 – **132.9*****

* RQ exceeds the acute listed species LOC of 0.1.
** RQ exceeds the acute non-listed species LOC of 0.5.
*** RQ exceeds the chronic LOC of 1.
N/A – risk quotient is not calculated for mammalian acute dietary-based or avian chronic dose-based scenarios.

Table 19. Bioaccumulation Risk Quotients for Mammals, Birds, Reptiles, and Amphibians Consuming Fish Contaminated by Fipronil Sulfide (MB 45950)

Wildlife Species	Acute		Chronic	
	Dose Based	Dietary Based	Dose Based	Dietary Based
Mammalian				
fog/water shrew	<0.001 -0.001	N/A	0.024 - 0.063	0.004 - 0.011
rice rat/star-nosed mole	0.001	N/A	0.029 - 0.077	0.004 - 0.011
small mink	0.001 -0.002	N/A	0.043 - 0.113	0.007 - 0.018
large mink	0.001 -0.002	N/A	0.047 - 0.125	0.007 - 0.018
small river otter	0.001 -0.002	N/A	0.051 - 0.135	0.007 - 0.018
large river otter	0.001 -0.002	N/A	0.037 - 0.092	0.005 - 0.011
Avian				
sandpipers	0.007 -0.018	0.001 - 0.003	N/A	0.013 - 0.034
cranes	< 0.001 -0.001	0.001 - 0.003	N/A	0.014 - 0.037
rails	0.004 - 0.010	0.001 - 0.004	N/A	0.015 - 0.040
herons	0.001 -0.002	0.001 - 0.004	N/A	0.017 - 0.044
small osprey	0.001 -0.003	0.002 - 0.005	N/A	0.021 - 0.054
white pelican	<0.001 -0.001	0.001 - 0.003	N/A	0.014 - 0.034

N/A – risk quotient is not calculated for mammalian acute dietary-based or avian chronic dose-based scenarios.

Table 20. Bioaccumulation Risk Quotients for Mammals, Birds, Reptiles, and Amphibians Consuming Fish Contaminated by Fipronil Sulfone (MB 46136)

Wildlife Species	Acute		Chronic	
	Dose Based	Dietary Based	Dose Based	Dietary Based
Mammalian				
fog/water shrew	0.001 – 0.004	N/A	0.093 – 0.634	0.017 – 0.114
rice rat/star-nosed mole	0.001 – 0.005	N/A	0.110 – 0.759	0.016 – 0.112
small mink	0.001 – 0.007	N/A	0.133 – 0.986	0.021 – 0.158
large mink	0.001 – 0.007	N/A	0.147 – **1.09*** **	0.021 – 0.158
small river otter	0.001 – 0.008	N/A	0.159 – **1.17*** **	0.021 – 0.158
large river otter	<0.001 – 0.003	N/A	0.025 – 0.376	0.003 – 0.047
Avian				
sandpipers	0.035 – **0.245***	0.006 – 0.040	N/A	0.049 – 0.336
cranes	0.002 – 0.014	0.006 – 0.041	N/A	0.049 – 0.348
rails	0.019 – **0.132***	0.007 – 0.046	N/A	0.056 – 0.390
herons	0.003 – 0.021	0.007 – 0.048	N/A	0.057 – 0.407
small osprey	0.005 – 0.036	0.008 – 0.056	N/A	0.064 – 0.473
white pelican	<0.001 – 0.004	0.001 – 0.017	N/A	0.009 – 0.140

*RQ exceeds the acute listed species LOC of 0.1.
***RQ exceeds the chronic LOC of 1.
N/A – risk quotient is not calculated for mammalian acute dietary-based or avian chronic dose-based scenarios.

Table 21. Bioaccumulation Risk Quotients for Mammals, Birds, Reptiles, and Amphibians Consuming Fish Contaminated by MB 46513

Wildlife Species	Acute		Chronic	
	Dose Based	Dietary Based	Dose Based	Dietary Based
Mammalian				
fog/water shrew	<0.001 – 0.001	N/A	0.001 – 0.014	<0.001 – 0.003
rice rat/star-nosed mole	<0.001 – 0.002	N/A	0.002 – 0.017	<0.001 – 0.002
small mink	<0.001 – 0.002	N/A	0.002 – 0.021	<0.001 – 0.003
large mink	<0.001 – 0.002	N/A	0.002 – 0.024	<0.001 – 0.003
small river otter	<0.001 – 0.002	N/A	0.002 – 0.026	<0.001 – 0.003
large river otter	<0.001 – 0.001	N/A	0.001 – 0.009	<0.001 – 0.001
Avian				
sandpipers	0.002 – 0.021	<0.001 – 0.001	N/A	0.001 – 0.007
cranes	<0.001 – 0.001	<0.001 – 0.001	N/A	0.001 – 0.008
rails	0.001 – 0.012	<0.001 – 0.001	N/A	0.001 – 0.009
herons	<0.001 – 0.002	<0.001 – 0.001	N/A	0.001 – 0.009
small osprey	<0.001 – 0.003	<0.001 – 0.001	N/A	0.001 – 0.010
white pelican	<0.001	<0.001	N/A	<0.001 – 0.004

N/A – risk quotient is not calculated for mammalian acute dietary-based or avian chronic dose-based scenarios.

VII. Effects to Endangered Species

Threatened and Endangered Species Concerns

Acute and chronic risk concerns were identified for listed mammals, birds, reptiles, and land-phase amphibians, and for listed and non-listed freshwater invertebrates, estuarine/marine invertebrates, and benthic invertebrates. Chronic risk concerns were identified for listed and

non-listed estuarine/marine fish, and acute risk concerns are possible for terrestrial invertebrates. Finally, listed terrestrial semi-aquatic monocots are also potentially at risk.

Listed Species

The LOCATES database (ver. 2.3.0) was used to identify endangered and threatened species that may experience direct or indirect risk from the expanded application of fipronil to the perimeters of man-made structures in 12 Louisiana parishes (Ascension, Calcasieu, East Baton Rouge, Iberville, Lafayette, Lafourche, Morehouse, Orleans, St. Bernard, St. Tammany, Terrebonne, and West Baton Rouge). Given that the proposed fipronil use is widespread (*i.e.*, not confined to agricultural areas), LOCATES was used to generate a list of the threatened/endangered species that may be present in each of the 12 affected parishes. Sixteen endangered or threatened species were identified in LOCATES including 2 birds, 3 bivalves, 1 fern, 2 fish, 2 mammals, and 6 reptiles (see Appendix 4 for a list of species by parish):

Birds

Red-cockaded woodpecker (*Picoides borealis*) (endangered)
Piping plover (*Charadrius melodus*) (endangered/threatened)

Bivalves

Rabbitsfoot (*Quadrula cylindrica cylindrica*) (threatened)
Pink mucket (pearlymussel) (*Lampsilis abrupta*) (endangered)
Alabama (inflated) heelsplitter (*Potamilus inflatus*) (threatened)

Ferns

Louisiana quillwort (*Isoetes louisianensis*) (endangered)

Fish

Pallid sturgeon (*Scaphirhynchus albus*) (endangered)
Gulf sturgeon (*Acipenser oxyrinchus desotoi*) (threatened)

Mammals

Louisiana black bear (*Ursus americanus luteolus*) (threatened)
West Indian manatee (*Trichechus manatus*) (endangered)

Reptiles

Kemp's ridley sea turtle (*Lepidochelys kempii*) (endangered)
Hawksbill sea turtle (*Eretmochelys imbricata*) (endangered)
Green sea turtle (*Chelonia mydas*) (endangered/threatened)
Gopher tortoise (*Gopherus polyphemus*) (threatened)
Ringed map turtle (*Graptemys oculifera*) (threatened)
Leatherback sea turtle (*Dermochelys coriacea*) (endangered)

VII. Conclusions

For the expanded perimeter treatment identified in this Section 18 for Louisiana, fipronil exposure to birds (used as a surrogate for reptiles and terrestrial-phase amphibians), mammals, and aquatic invertebrates is expected to result in direct acute and chronic risk concerns for listed and non-listed species. Chronic concerns (listed and non-listed species) were identified for

estuarine/marine fish. Listed terrestrial semi-aquatic monocots may also be at direct risk. In addition, since the compound is toxic to bees, it is assumed that there may be risk to listed and non-listed terrestrial invertebrates should exposure occur.

VIII. Bibliography

Arnot, J.A. and F.A.P.C. Gobas. 2004. A food web bioaccumulation model for organic chemicals in aquatic ecosystems. Environmental Toxicology and Chemistry, 23 (10): 2343-2355.

Konwick, B.J., A.T. Fisk, A.W. Garrison, J.K. Avantis, and M.C. Black. 2005. Acute enantioselecctive toxicity of fipronil and its deulfinyl photoproduct to *Ceriodaphnia dubia*. *Environmental Toxicology and Chemistry*, 24: 2350-2355.

Mayer, D.F., and J.D. Lunden. 1999. Field and laboratory tests of the effects of fipronil on adult female bees of *Apis mellifera, Megachile rotundata* and *Nomia melanderi*. *Journal of Apicultural Research*, 38(3-4): 191-197.

Oliveira Jacob, C.R., H.M. Soares, S.M. Carvalho, R. C. Ferreira Nocelli, and O. Malaspina. 2013. *Bull. Environ. Contam. Toxicol*, 90: 69-72.

Overmyer, J.P., B.N. Mason, K.L Armbrust. 2005. Acute toxicity of imidacloprid and fipronil to a nontarget aquatic insect, *Simulium vittatum* Zetterstedt cytospecies IS-7. *Bull. Env. Contam. Toxicol.* 74:872-879.

USEPA. 2007. Ecological Risk Assessment for Fipronil Uses. Office of Pesticide Programs, United States Environmental Protection Agency. DP Barcodes: 331595, 331519, 331593, 329522, 314530, 332424, 325983, 326009, 326000, 325999, 325997, 325990, 326003, 331867, 314530, 322414, 314197, 331714, 331713, 313295, 331872, and 335805

Appendix 1. Representative KABAM Output

Table 11. Estimated concentrations of MB45613 in ecosystem components.				
Ecosystem Component	**Total concentration (µg/kg-ww)**	**Lipid normalized concentration (µg/kg-lipid)**	**Contribution due to diet (µg/kg-ww)**	**Contribution due to respiration (µg/kg-ww)**
Water (total)*	0	N/A	N/A	N/A
Water (freely dissolved)*	0	N/A	N/A	N/A
Sediment (pore water)*	2	N/A	N/A	N/A
Sediment (in solid)**	99	N/A	N/A	N/A
Phytoplankton	21	1028	N/A	20.55
Zooplankton	15	506	0.08	15.09
Benthic Invertebrates	76	2522	0.80	74.85
Filter Feeders	50	2488	0.51	49.24
Small Fish	98	2461	2.57	95.87
Medium Fish	103	2576	7.76	95.30
Large Fish	35	880	14.43	20.76
* Units: µg/L; **Units: µg/kg-dw				

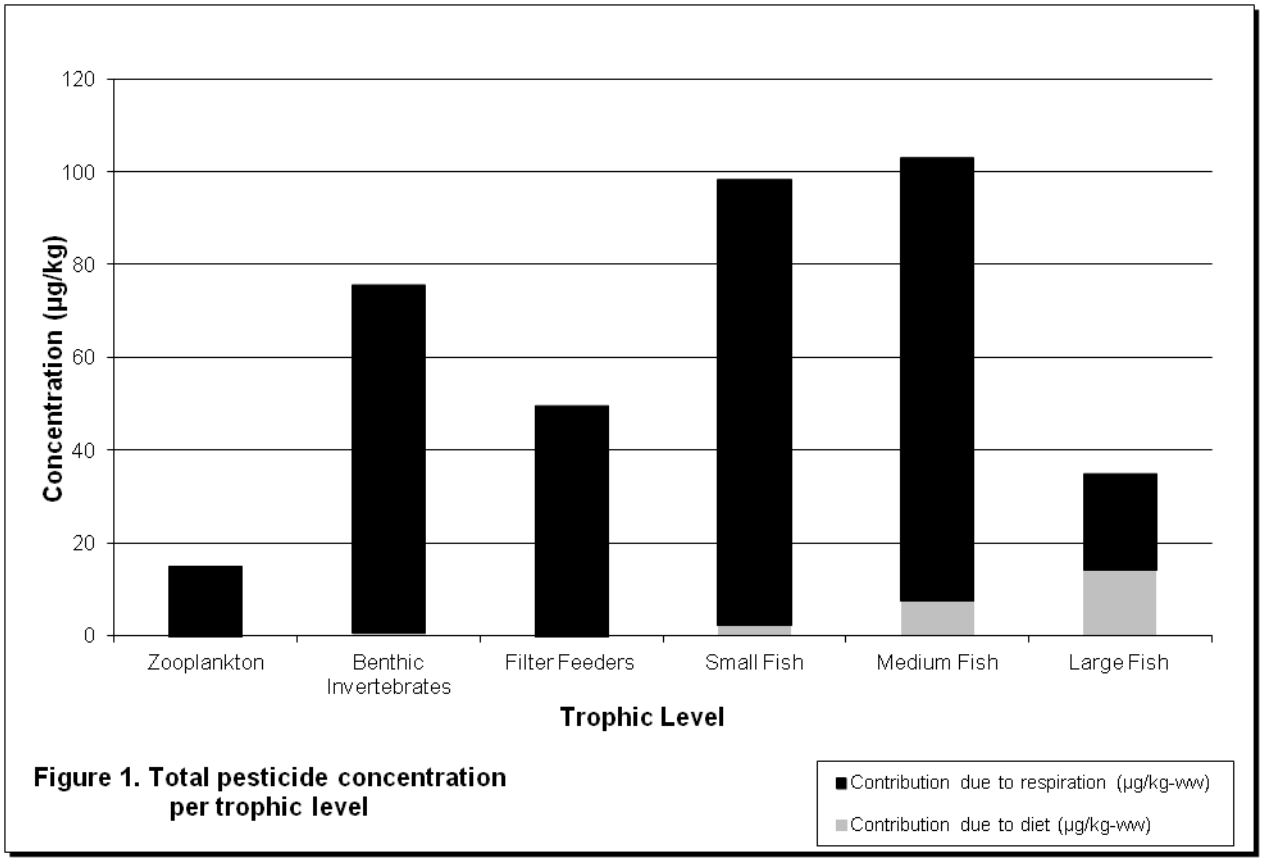

Figure 1. Total pesticide concentration per trophic level

Table 12. Total BCFand BAF values of MB45613 in aquatic trophic levels.		
Trophic Level	**Total BCF (µg/kg-ww)/(µg/L)**	**Total BAF (µg/kg-ww)/(µg/L)**
Phytoplankton	798	773
Zooplankton	568	571
Benthic Invertebrates	2824	2846
Filter Feeders	1858	1872
Small Fish	3632	3704
Medium Fish	3632	3878
Large Fish	798	1324

Table 13. Lipid-normalized BCF, BAF, BMF and BSAF values of MB45613 in aquatic trophic levels.				
Trophic Level	**BCF (µg/kg-lipid)/(µg/L)**	**BAF (µg/kg-lipid)/(µg/L)**	**BMF (µg/kg-lipid)/(µg/kg-lipid)**	**BSAF (µg/kg-lipid)/(µg/kg-OC)**
Phytoplankton	39875	38668	N/A	0
Zooplankton	18948	19034	0.49	0
Benthic Invertebrates	94146	94883	4.98	1
Filter Feeders	92903	93617	4.92	1
Small Fish	90810	92599	1.63	1
Medium Fish	90810	96942	1.03	1
Large Fish	19954	33098	0.34	0

Table 14. Calculation of EECs for mammals and birds consuming fish contaminated by MB45613.						
Wildlife Species	**Biological Parameters**				**EECs (pesticide intake)**	
	Body Weight (kg)	**Dry Food Ingestion Rate (kg-dry food/kg-bw/day)**	**Wet Food Ingestion Rate (kg-wet food/kg-bw/day)**	**Drinking Water Intake (L/d)**	**Dose Based (mg/kg-bw/d)**	**Dietary Based (ppm)**
Mammalian						
fog/water shrew	0.02	0.140	0.585	0.003	0.044	0.08
rice rat/star-nosed mole	0.1	0.107	0.484	0.011	0.036	0.07
small mink	0.5	0.079	0.293	0.048	0.030	0.10
large mink	1.8	0.062	0.229	0.168	0.024	0.10

small river otter	5.0	0.052	0.191	0.421	0.020	0.10
large river otter	15.0	0.042	0.157	1.133	0.006	0.04
Avian						
sandpipers	0.0	0.228	1.034	0.004	0.0774	0.07
cranes	6.7	0.030	0.136	0.211	0.0104	0.08
rails	0.1	0.147	0.577	0.010	0.0503	0.09
herons	2.9	0.040	0.157	0.120	0.0141	0.09
small osprey	1.3	0.054	0.199	0.069	0.0206	0.10
white pelican	7.5	0.029	0.107	0.228	0.0038	0.04

Table 15. Calculation of toxicity values for mammals and birds consuming fish contaminated by MB45613.

	Toxicity Values			
	Acute		**Chronic**	
Wildlife Species	**Dose Based (mg/kg-bw)**	**Dietary Based (mg/kg-diet)**	**Dose Based (mg/kg-bw)**	**Dietary Based (mg/kg-diet)**
Mammalian				
fog/water shrew	33.60	N/A	3.15	30
rice rat/star-nosed mole	22.79	N/A	2.14	30
small mink	15.03	N/A	1.41	30
large mink	10.62	N/A	1.00	30
small river otter	8.23	N/A	0.77	30
large river otter	6.25	N/A	0.59	30
Avian				
sandpipers	3.60	119.20	N/A	10
cranes	8.62	119.20	N/A	10
rails	4.35	119.20	N/A	10
herons	7.60	119.20	N/A	10
small osprey	6.70	119.20	N/A	10

white pelican	8.76	119.20	N/A	10

Table 16. Calculation of RQ values for mammals and birds consuming fish contaminated by MB45613.

Wildlife Species	Acute		Chronic	
	Dose Based	Dietary Based	Dose Based	Dietary Based
Mammalian				
fog/water shrew	0.001	N/A	0.014	0.003
rice rat/star-nosed mole	0.002	N/A	0.017	0.002
small mink	0.002	N/A	0.021	0.003
large mink	0.002	N/A	0.024	0.003
small river otter	0.002	N/A	0.026	0.003
large river otter	0.001	N/A	0.009	0.001
Avian				
sandpipers	0.021	0.001	N/A	0.007
cranes	0.001	0.001	N/A	0.008
rails	0.012	0.001	N/A	0.009
herons	0.002	0.001	N/A	0.009
small osprey	0.003	0.001	N/A	0.010
white pelican	0.000	0.000	N/A	0.004

Appendix 2. Example of TerrPlant Model Inputs/Outputs (Version 1.2.2, December 2006)

Table 1. Chemical Identity.	
Chemical Name	**Fipronil**
PC code	**129121**
Use	**Perimeter spray**
Application Method	**Ground**
Application Form	**Spray**
Solubility in Water (ppm)	**2.3**

Table 2. Input parameters used to derive EECs.			
Input Parameter	**Symbol**	**Value**	**Units**
Application Rate	A	**0.327**	**y**
Incorporation	I	**1**	none
Runoff Fraction	R	**0.01**	none
Drift Fraction	D	**0.01**	none

Table 3. EECs for Fipronil. Units in y.		
Description	**Equation**	**EEC**
Runoff to dry areas	(A/I)*R	0.00327
Runoff to semi-aquatic areas	(A/I)*R*10	0.0327
Spray drift	**A*D**	**0.00327**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.00654**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**0.03597**

Table 4. Plant survival and growth data used for RQ derivation. Units are in y.				
	Seedling Emergence		**Vegetative Vigor**	
Plant type	**EC_{25}**	**NOAEC**	**EC_{25}**	**NOAEC**
Monocot	**7.1**	**0.011**	**x**	**x**
Dicot	**4.62**	**1.02**	**x**	**x**

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Fipronil through runoff and/or spray drift.*				
Plant Type	**Listed Status**	**Dry**	**Semi-Aquatic**	**Spray Drift**
Monocot	non-listed	<0.1	<0.1	<0.1
Monocot	listed	0.59	3.27	0.30
Dicot	non-listed	<0.1	<0.1	<0.1
Dicot	listed	<0.1	<0.1	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

Appendix 3. Example of T-REX Model Inputs (Version 1.5.2, June 2013)

This spreadsheet-based model calculates the residues on avian and mammalian food items along with the dissipation rate of a chemical applied to foliar surfaces (for single or multiple applications) to estimate acute and reproductive risk quotients. The results are presented by weight class for various sized mammals for the maximum application rate and number of applications proposed in the Section 18 application.

Chemical Identity and Application Information

Chemical Name:	Fipronil
Seed Treatment? (Check if yes)	FALSE
Use:	
Product name and form:	
% A.I. (leading zero must be entered for formulations <1% a.i.):	100.00%
Application Rate (lb ai/acre)	0.327
Half-life (days):	35
Application Interval (days):	60
Number of Applications:	2
Are you assessing applications with variable rates or intervals?	no

Avian

Endpoint	Toxicity value	Indicate test species below
LD50 (mg/kg-bw)	11.30	Bobwhite quail
LC50 (mg/kg-diet)	48.00	Bobwhite quail
NOAEL (mg/kg-bw)		Bobwhite quail
NOAEC (mg/kg-diet)	10.00	Bobwhite quail

Enter the Mineau et al. Scaling Factor 1.15

Mammalian

		Acute Study	Chronic Study
Size (g) of mammal used in toxicity study Default rat body weight is 350 grams		350	350
Endpoint	**Toxicity value**		**Reference (MRID)**
LD50 (mg/kg-bw)	97.00		
LC50 (mg/kg-diet)			
Reported Chronic Endpoint	2.50	mg/kg-diet	
Is estimated daily dose (mg/kg-bw) reported from the available chronic mammal study? (yes or no)	no		

Estimated Chronic Daily Dose Equivalent to reported Chronic Dietary Endpoint	0.125	mg/kg-bw based on standard FDA lab rat conversion

Chemical Identity and Application Information

Chemical Name:	MB 45950
Seed Treatment? (Check if yes)	☐ FALSE
Use:	
Product name and form:	
% A.I. (leading zero must be entered for formulations <1% a.i.):	100.00%
Application Rate (lb ai/acre)	0.016
Half-life (days):	35
Application Interval (days):	60
Number of Applications:	2
Are you assessing applications with variable rates or intervals?	no

Avian

Endpoint	Toxicity value	Indicate test species below

LD50 (mg/kg-bw)	26.80	Bobwhite quail
LC50 (mg/kg-diet)	114.00	Bobwhite quail
NOAEL (mg/kg-bw)		Bobwhite quail
NOAEC (mg/kg-diet)	10.00	Bobwhite quail

Enter the Mineau et al. Scaling Factor 1.15

Mammalian

		Acute Study	Chronic Study
Size (g) of mammal used in toxicity study Default rat body weight is 350 grams		350	350
Endpoint	**Toxicity value**		**Reference (MRID)**
LD50 (mg/kg-bw)	83.00		
LC50 (mg/kg-diet)			
Reported Chronic Endpoint	2.50	mg/kg-diet	
Is estimated daily dose (mg/kg-bw) reported from the available chronic mammal study? (yes or no)	no		

Estimated Chronic Daily Dose Equivalent to reported Chronic Dietary Endpoint	0.125	mg/kg-bw based on standard FDA lab rat conversion

Chemical Identity and Application Information

Chemical Name:	MB 46513	
Seed Treatment? (Check if yes)	☐	FALSE
Use:		
Product name and form:		
% A.I. (leading zero must be entered for formulations <1% a.i.):	100.00%	
Application Rate (lb ai/acre)	0.078	

Half-life (days):	35
Application Interval (days):	60
Number of Applications:	2
Are you assessing applications with variable rates or intervals?	no

Avian

Endpoint	Toxicity value	Indicate test species below
LD50 (mg/kg-bw)	5.00	Bobwhite quail
LC50 (mg/kg-diet)	119.20	Bobwhite quail
NOAEL (mg/kg-bw)		Bobwhite quail
NOAEC (mg/kg-diet)	10.00	Bobwhite quail

Enter the Mineau et al. Scaling Factor 1.15

Mammalian

		Acute Study	Chronic Study
Size (g) of mammal used in toxicity study Default rat body weight is 350 grams		350	350
Endpoint	**Toxicity value**		**Reference (MRID)**
LD50 (mg/kg-bw)	16.00		
LC50 (mg/kg-diet)			
Reported Chronic Endpoint	2.50	mg/kg-diet	
Is estimated daily dose (mg/kg-bw) reported from the available chronic mammal study? (yes or no)	no		

Estimated Chronic Daily Dose Equivalent to reported Chronic Dietary Endpoint	0.125	mg/kg-bw based on standard FDA lab rat conversion

Appendix 4. LOCATES Database Search Results – List of Endangered and Threatened Species in Louisiana (Ascension, Calcasieu, East Baton Rouge, Iberville, Lafayette, Lafourche, Morehouse, Orleans, Terrebonne, St. Bernard, St. Tammany, and West Baton Rouge)

Ascension
Alabama (inflated) heelsplitter (*Potamilus inflatus)*
Gulf sturgeon (*Acipenser oxyrinchus desotoi*)
Louisiana black bear (*Ursus americanus luteolus*)
Pallid sturgeon (*Scaphirhynchus albus*)
West Indiana manatee (*Trichechus manatus*)

Calcasieu
Louisiana black bear (*Ursus americanus luteolus*)
Red-cockaded woodpecker (*Picoides borealis*)

East Baton Rouge
Alabama (inflated) heelsplitter (*Potamilus inflatus)*
Gulf sturgeon (*Acipenser oxyrinchus desotoi*)
Louisiana black bear (*Ursus americanus luteolus*)
Pallid sturgeon (*Scaphirhynchus albus*)
West Indiana manatee (*Trichechus manatus*)

Iberville
Gulf sturgeon (*Acipenser oxyrinchus desotoi*)
Louisiana black bear (*Ursus americanus luteolus*)
Pallid sturgeon (*Scaphirhynchus albus*)

Lafayette
Louisiana black bear (*Ursus americanus luteolus*)

Lafourche
Green sea turtle (*Chelonia mydas*)
Gulf sturgeon (*Acipenser oxyrinchus desotoi*)
Hawksbill sea turtle (*Eretmochelys imbricate*)
Kemp's ridley sea turtle (*Lepidochelys kempii*)
Leatherback sea turtle (*Dermochelys coriacea*)
Louisiana black bear (*Ursus americanus luteolus*)
Piping plover (*Charadrius melodus*)
West Indiana manatee (*Trichechus manatus*)

Morehouse
Louisiana black bear (*Ursus americanus luteolus*)
Pink mucket (pearlymussel) (*Lampsilis abrupta*)
Rabbitsfoot (*Quadrula cylindrica cylindrica)*
Red-cockaded woodpecker (*Picoides borealis*)

Orleans
Gulf sturgeon (*Acipenser oxyrinchus desotoi*)
Louisiana black bear (*Ursus americanus luteolus*)
Pallid sturgeon (*Scaphirhynchus albus*)
West Indiana manatee (*Trichechus manatus*)

St. Bernard
Green sea turtle (*Chelonia mydas*)
Gulf sturgeon (*Acipenser oxyrinchus desotoi*)
Hawksbill sea turtle (*Eretmochelys imbricate*)
Kemp's ridley sea turtle (*Lepidochelys kempii*)
Leatherback sea turtle (*Dermochelys coriacea*)
Louisiana black bear (*Ursus americanus luteolus*)
Pallid sturgeon (*Scaphirhynchus albus*)
Piping plover (*Charadrius melodus*)
West Indiana manatee (*Trichechus manatus*)

St. Tammany
Alabama (inflated) heelsplitter (*Potamilus inflatus)*
Gopher tortoise (*Gopherus polyphemus*)
Gulf sturgeon (*Acipenser oxyrinchus desotoi*)
Louisiana black bear (*Ursus americanus luteolus*)
Louisiana quillwort (*Isoetes louisianensis*)
Red-cockaded woodpecker (*Picoides borealis*)
Ringed map turtle (*Graptemys oculifera*)
West Indiana manatee (*Trichechus manatus*)

Terrebonne
Green sea turtle (*Chelonia mydas*)
Gulf sturgeon (*Acipenser oxyrinchus desotoi*)
Hawksbill sea turtle (*Eretmochelys imbricate*)
Kemp's ridley sea turtle (*Lepidochelys kempii*)
Leatherback sea turtle (*Dermochelys coriacea*)
Louisiana black bear (*Ursus americanus luteolus*)
Piping plover (*Charadrius melodus*)
West Indiana manatee (*Trichechus manatus*)

West Baton Rouge
Louisiana black bear (*Ursus americanus luteolus*)
Pallid sturgeon (*Scaphirhynchus albus*)